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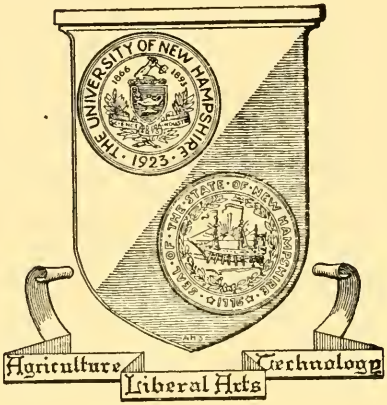

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Agricultural Research in New Hampshire

Annual Report of the Director of the
Agricultural Experiment Station
For the Year Ending
June 30, 1943

DURHAM, NEW HAMPSHIRE

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NEW HAMPSHIRE AGRICULTURAL EXPERIMENT STATION STAFF
1943-44

ADMINISTRATION

M. Gale Eastman, Ph.D., Dean and Director
Harold C. Grinnell, Ph.D., Assistant to Dean and Director
Raymond C. Magrath, Treasurer
John H. Baker, B.S., Assistant to Treasurer
Camilla Romstad, Publications Editor
Thelma Brackett, A.B., Librarian
Lurlene Gordon, B.S., Assistant in Charge, Plant and Animal Science Library

AGRICULTURAL AND BIOLOGICAL CHEMISTRY

Thomas G. Phillips, Ph.D., Chemist
Todd O. Smith, M.S., Associate Chemist
Stanley R. Shimer, M.S., Assistant Chemist
Gordon P. Percival, M.S., Assistant Chemist
Helen J. Purington, Ph.D., Assistant Chemist
Arthur E. Teeri, Ph.D., Assistant Chemist
Henry A. Davis, M.S., Assistant in Agricultural and Biological Chemistry

AGRICULTURAL ECONOMICS

Harry C. Woodworth, M.S., Agricultural Economist
Max F. Abell, Ph.D., Assistant Agricultural Economist
Harold C. Grinnell, Ph.D., Assistant Agricultural Economist
Lawrence A. Dougherty, B.S., Assistant Economist in Marketing
Dean Hosken, B.A., Research Assistant in Agricultural Economics
John C. Holmes, A.B., Research Assistant in Agricultural Economics

AGRONOMY

Ford S. Prince, B.S., Agronomist
Paul T. Blood, M.S., Assistant Agronomist
Leroy J. Higgins, B.S., Assistant Agronomist
Louis T. Kardos, Ph.D., Assistant Agronomist
Betty G. Sanborn, Seed Analyst

ANIMAL HUSBANDRY

Ernest G. Ritzman, M.S., Research Professor in Animal Husbandry
Nicholas F. Colovos, M.S., Research Assistant in Animal Husbandry
Albert D. Littlehale, Herdsman

BACTERIOLOGY

Lawrence W. Slanetz, Ph.D., Bacteriologist
Theresa Sicilian, B.S., Graduate Assistant in Bacteriology
Dorothy Tuttle, B.S., Laboratory Technician

BOTANY

Albion R. Hodgon, Ph.D., Plant Taxonomist
Stuart Dunn, Ph.D., Plant Physiologist
Mathias C. Richards, Ph.D., Plant Pathologist
Raymond N. Barratt, Research Assistant in Botany
Helen R. Barratt, Research Assistant in Botany

DAIRY

Kenneth S. Morrow, M.S., Dairy Husbandman
Herbert C. Moore, M.S., Assistant Dairy Husbandman
Harry A. Keener, Ph.D., Assistant Dairy Husbandman

ENTOMOLOGY

Walter C. O'Kane, M.A., D.Sc., Entomologist
James G. Conklin, Ph.D., Associate Entomologist
Leon C. Glover, Ph.D., Research Assistant in Entomology
Joseph W. Enke, B.S., Research Assistant in Entomology

FORESTRY

Clark L. Stevens, M.F., Ph.D., Forester
Lewis C. Swain, M.F., Assistant Forester

HOME ECONOMICS

Tatiana Levcowich, M.S., Research Assistant in Home Economics
Alice M. King, B.S., Field Assistant in Nutrition Research

HORTICULTURE

Albert F. Yeager, Ph.D., Horticulturist
L. Phelps Latimer, Ph.D., Assistant Horticulturist
Henry S. Clapp, M.S., Assistant Horticulturist
Winfred D. Holley, M.S., Research Assistant in Horticulture
Russell Eggert, M.S., Research Assistant in Horticulture
James Macfarlane, Greenhouse Assistant

POULTRY

T. Burr Charles, M.S., Poultry Husbandman
Fred E. Allen, D.V.M., Veterinarian
Ernest L. Waller, D.V.M., Poultry Pathologist
Alan C. Corbett, D.V.M., Assistant Poultry Pathologist
Richard C. Ringrose, Ph.D., Assistant Poultry Husbandman
Henry E. Parker, B.S., R.O.P. Supervisor
Richard Ford, Assistant Technician in Poultry Husbandry
Harriet L. Goodwin, B.S., Laboratory Technician in Poultry Husbandry
Madeline Papachristos, B.S., Assistant Laboratory Technician in Poultry Husbandry
Ruth E. Rinta, Assistant Laboratory Technician in Poultry Husbandry
Frances Mitchell, Laboratory Assistant in Poultry Husbandry

ASSISTANTS TO THE STAFF

Beatrice M. Richmond, Cashier
Elizabeth E. Mehaffey, Mailing Clerk
Elizabeth E. McFadden, Clerk
Martha E. Fisher, Stenographer
Kathrina H. Legg, Stenographer
Amber M. Hall, Stenographer
Sara M. Sanborn, Stenographer
Laverna E. Murphy, Stenographer
Eileen McLaughlin, M.S., Stenographer
Edith M. Smith, Stenographer
Raymah V. Morrill, Stenographer
Sarah E. Green, Stenographer
Avis G. Cross, Stenographer
Ruth H. Johnson, Stenographer
Ruth A. Dearborn, Stenographer
Gwen K. Lamere, Stenographer
Adrienne Girard, Stenographer

Agricultural Research in New Hampshire

ANOTHER YEAR of war has had its repercussions on research work in agriculture. Problems of maintenance of personnel, as well as the replacement and addition of equipment, are bound to increase with the need for more men and more machines for the ever-broadening and more intensified battle fronts. To all this must be added the newer demands for farm research in the solution of acute problems incident to an ever-increasing need for food production, regardless of lessening supplies of labor, feed, fertilizer, equipment and what not. On the spur of the moment, so to speak, much of the time and energy in our organization have been directed toward searching out suitable substitutes for unobtainable supplies in the feeding of animals, in the fertilizing of crops, or in the protection of crops against diseases and insects. Again, studies of the conservation of gas and tires in marketing farm products and the more efficient use of machinery and human labor on the farm have led to some interesting discoveries.

BUILDINGS

Partitions in the basement of Morrill Hall have been rearranged to provide more room for agricultural economics, particularly for statistical laboratory work, and an additional small office has been made possible. For Entomology, a new glass extension at the rear of Nesmith Hall has provided some 1600 square feet of laboratory space of a greenhouse nature. At the same time, this arrangement has released a somewhat comparable space in the university greenhouses for the use of botany and horticulture. One of our sheep barns has had its dirt floor replaced with concrete on which adjustable stalls and stanchions will be erected to provide for the accommodation of a more adequate population of calves and other livestock units in our feeding projects.

EQUIPMENT

In spite of buying handicaps we have been able, with patience and persistence, to add some new equipment of much importance in pursuing new projects geared to the war effort. For example, a Beckman spectrophotometer and a Klett fluorimeter have added much to our resourcefulness in biological chemistry and home economics. An ophthalmoscope is proving useful in experimental nutrition work with larger animals. Also, ordinary needs in the line of analytical balances, ovens, refrigerators, etc., have been met reasonably well, sometimes with new equipment, but quite as often by swapping between laboratories on campus or by purchasing them second-hand. For our field work, particularly in agronomy, we were able to buy a Ford-Ferguson outfit of tractor and equipment, without which it would have been impossible to provide man and equipment labor to continue some of our plot work. Toward the same end, a mower for the horticulture tractor has been of inestimable value in performing the orchard work and accomplishing it on time.

CHANGES IN PERSONNEL

In Administration, Arval L. Erikson, assistant to the director, who was given a year's leave of absence to serve with the Office of Price Administration in Washington, resigned at the end of his leave, May 15, 1942. John C. Sim, editor, resigned at the end of the previous fiscal year to take his place in the armed forces. John T. Kangas, assistant editor, resigned September 5, 1942 to take a similar position with Cornell University. David Jolly, university librarian, resigned August 31, 1942 to assume the position of librarian at Hampton Institute and Robert B. Sears, assistant in charge, plant and animal sciences library, resigned August 31, 1942 for military service. Miss Camilla Romstad was appointed publications editor October 1, 1942. Miss June M. Owen was appointed as assistant editor at the beginning of the fiscal year and served until November 3, 1942. Miss Thelma Brackett was appointed university librarian, September 1, 1942. Miss Lurlene Gordon was appointed library assistant in charge of plant and animal sciences library, September 3 of the same year.

Two assistant chemists, Miss Helen J. Purinton and Arthur E. Teeri were added to the staff in Agricultural and Biological Chemistry on May 17 and May 1, 1943, respectively.

John C. Holmes, for several years employed as an assistant in the field with land use and similar studies, was given a definite contract as research assistant in Agricultural Economics, January 1, 1943.

In Agronomy, we lost C. L. W. Swanson who was called in as a reserve officer in the army, July 1, 1942; also, Walter H. Lyford who left us September 12, 1942 to accept a similar position with the U. S. D. A. Louis T. Kardos was appointed as assistant agronomist, June 1, 1943.

With the relinquishing of our sheep project Albert Littlehale, shepherd, became herdsman in the department of Animal Husbandry with a title change to correspond.

Mrs. Bessie G. Sanborn severed her connection with Bacteriology in order to give all her time to seed testing in Agronomy. Arthur F. Howe completed his work as graduate assistant in Bacteriology as of June 30, 1942. Miss Edythe M. Kenney and Arthur J. Shanahan served as technical assistant and graduate assistant, respectively, for the fiscal year. Miss Theresa Sicilian was appointed graduate assistant as of July 1, 1943 and Mrs. Dorothy Tuttle was also appointed as laboratory technician for the new fiscal year.

Raymond W. Barratt was changed on March 22, 1943 from a graduate assistant in Botany to a full-time worker with the title of research assistant. Mrs. Helen R. Barratt was hired also as a research assistant as of March 8, 1943.

In Entomology, Anthony Standen, research chemical assistant, completed his assignment at the end of the fiscal year. Joseph W. Enke succeeded him with the title of research assistant.

William A. Johnson was given an assignment in Forestry Extension work in this state, September 15, 1943.

Miss Wilmer D. Brewer in Home Economics resigned at the end of the fiscal year, June 30, 1943, to take a position nearer home. Mrs. Alice M. King, hired on a temporary basis, had her contract extended to August 31.

The Horticulture department lost William W. Smith, research assistant, to the armed services, February 1, 1943. William P. Haulbrich, assistant in research, left at the beginning of the fiscal year to do commercial horticulture work. Russell Eggert was added as part-time research assistant, September 1, 1942.

Carl W. Hess, research assistant and Record of Performance supervisor, left the Poultry department, October 1, 1942, expecting to be drafted, and temporarily accepted employment on a dairy farm near his home in Iowa. Richard C. Ringrose was appointed assistant poultry husbandman, October 1, 1942. Henry E. Parker took the position of R.O.P. inspector, July 1, 1942. Miss Ruth E. Rinta was hired as assistant laboratory technician September 1, 1942, Miss Frances Mitchell, who was employed to help in the laboratory, was given a contract as laboratory assistant on March 1, 1943.

Among stenographers we lost Miss Katherine C. Wentworth, Miss Dorothy A. Griffin, Miss Jessie E. Page, Miss Virginia W. Linscott, Miss Marion A. Holbrook, and Miss Barbara Fuller. Replacements in a few cases have come and gone, but the following new employees are on the job: Miss Ruth Johnson, Mrs. Ruth Dearborn, Miss Raymah V. Morrill, Mrs. Gwen Lamere, Miss Avis G. Cross, Miss Sarah E. Green.

PUBLICATIONS

Station Bulletins

341 Results of Seed Tests 1942

342 Inspection of Commercial Feeding Stuffs for 1942

343 Inspection of Commercial Fertilizers for 1942

344 Land Utilization in New Hampshire. II. Summer Homes and the Rural Economy

345 Agricultural Research in New Hampshire

346 Studies in Local Government and Taxation in Rural New Hampshire (in print)

347 Marketing New Hampshire McIntosh Apples (in print)

Station Circulars

63 Fertilizers for Sweet Corn

64 Credit Problems in Wholesale Milk Areas of New Hampshire

65 The Colebrook Plan for Milk Transportation

66 The Influence of Forest Management on the Local Economy of Dorchester (in print)

Technical Bulletins — None

Scientific Contributions

83 Organic Carbon Level of New Hampshire Soils Under Virgin, General Farm and Experimental Conditions

84 Isolation of a Filterable Virus from Chickens Affected with "Blue Comb."

85 The Potency of Digitalis Purpurea Cultivated in New Hampshire

86 The Effect of Light Intensity on the Photosynthetic Efficiency of Carnation Varieties

87 Development of the Storage Disorder of "Brown Core" in the McIntosh Apple

88 Response of Strawberries to Boron (in print)

89 The Palatability of Freshly Fallen Forest Tree Leaves to Millipeds

THIS REPORT

In the following pages some brief resume is given of the various projects and services carried on by the New Hampshire Agricultural Experiment Station during the fiscal twelve months beginning July 1, 1942 and ending June 30, 1943. There is no attempt to make these descriptions detailed or complete. They are merely suggestive. Any person interested in further information should feel free to make inquiries at any time by letter, or otherwise, contacting the director or any staff member.

Visitors to the university campus are welcomed, but the exacting work and off-campus demands for the services of many of our personnel, particularly in these times, may require appointments in advance to avoid disappointment to outsiders who may be seeking specific information or direction.

The director and staff solicit suggestions, advice, and constructive criticism relating to present or prospective undertakings in agricultural research that may benefit rural life from any farmer or other interested person at any time.

In the pursuit of our work we find it necessary to invite the farm people to cooperate with us constantly on their own farms in different parts of the state. They continually furnish information. Often they also allocate land, and, sometimes, plants and animals from varying conditions of climate and care for observation and treatment. We are highly appreciative of the willing cooperation and consideration which we receive. Without them our experimental work would be sadly handicapped.

M. Gale Eastman
Director

AGRICULTURAL ECONOMICS

The department of Agricultural Economics is directing its resources toward the national emergency. The objective of two projects is the conservation of trucking facilities. During the year another project was initiated to determine ways and means of using milking machines to better advantage in order to save time in this period of labor shortage. Under another one, observations have been made concerning the contribution of a rural area to the war effort, and an analysis is also under way to determine some of the necessary adjustments in view of the postwar period.

Much of the other work, such as pasture improvement and marketing, has a timely relationship to the problem of increasing food production.

The activities on certain projects require considerable travel and the field work has been curtailed to some extent due to the gasoline situation.

The following projects were active in the year ending June 30, 1943:

A Study of the Agricultural Conservation Program in Selected Areas of New Hampshire.

The Place of a Small Inland Town in the War and Postwar Economy. (Northwood and the War Economy).

Marketing McIntosh Apples.

A Study of the Supply and Distribution of New Hampshire Milk.

Adjustments in Transportation and Marketing New Hampshire Agricultural Products to Meet Wartime Conditions—Egg Transportation.

Economies in Purchases Made by Farmers.

Spray Management (See Fruit Production).

Pasture Management (See Pastures).

Efficient Chore Practices in Dairy Barns (See Dairying).

Operation of the Agricultural Conservation Program

An analysis was made of the economic problems involved in a ten-year pasture improvement project. Available data from agronomy and farm management projects were used as a basis to indicate some of the problems in building and maintaining pasture productivity. Pastures respond to lime and fertilizers in varying degrees depending upon the existing cover and fertility. Several patterns of response based on general data and observations were assumed, and the results to be expected were plotted for a series of years. This was based on a program of improving 1/10 of the required pasture each year.

Because of the present depleted condition of most pastures and the time required in building these to full productivity, there is a considerable time lag between costs and returns. It was estimated that the accumulated returns in many instances would not equal the accumulated costs during the first six or seven years of the program. Thus, the improvement of badly depleted and bushy pastures on a ten-year program requires an

out-of-pocket investment for several years before equal returns can be expected. No doubt this is one reason why many farmers have not carried on the ten-year pasture improvement program.

Under these conditions it would seem advisable that the Agricultural Conservation Program direct its resources toward aiding the farmer over this initial period of investment. Furthermore, it is suggested that greater emphasis be placed on lime and superphosphate for pastures.

H. C. Woodworth, D. Hosken

The Place of a Small Inland Town in the War and Postwar Economy

Located in an area of declining agriculture and with no local industries, Northwood's chief contribution to the war effort is manpower. Thirty-eight per cent of the entire working force are employed full time toward winning the war, either as servicemen (18 per cent) or as defense plant workers (20 per cent). For a number of years the trend in land has been away from the earlier agricultural pursuits until today most of the property is used as rural residences for persons who are employed in the surrounding cities, as summer places, or as homes of retired persons. Over 70 per cent of the working population are employed out of town and many of these supplement their incomes by living on small part-time farms. Northwood is ideally located for summer activities and, accordingly, there are 160 camps and 40 summer homes on the nine lakes in the hills or on the federal highway which runs through the center of town. The summer people provide the principal market for the town's remaining commercial agricultural enterprises.

Although Northwood was once an important shoe manufacturing center, it is no longer economically located for a large industry; but small town industries using local labor and raw materials are a postwar possibility. However, Northwood is most likely to continue primarily as a year-round residential suburb for workers in the industries of the surrounding cities and as a summer resort for vacationists from the urban centers, such as Boston and New York.

D. Hosken

Marketing McIntosh Apples

Best returns on low-grade McIntosh apples have been received from sales at farms or in near-by markets. In fact, cases have been noted where the net return from sales on grades below the Fancy grade exceeded those for Fancy apples which had been stored and sold in city markets.

Careful handling is exceedingly important with the lower grades of McIntosh. Those in grades below Fancy, if in good condition, are usually more palatable than those from a Fancy pack which have become soft and bruised. Over half the bruising occurs after apples leave the growers' storage. Those which were rehandled in the stores had about 50 per cent more large bruises than those sold from original containers. Conspicuous bruising is all too common in our large sizes of McIntosh. They are softer than smaller sizes and need special care in handling. That such care will be well repaid is indicated by test sales made in retail stores. Unbruised lots sold three and one-half times faster at a much greater margin.

The details of this study are now being published as Experiment Station Bulletin 347, Marketing New Hampshire McIntosh Apples.

L. A. Dougherty, A. F. Yeager

The Supply and Distribution of New Hampshire Milk

In order to further a contribution to the war effort, current activities on this project have focused around conservation of the dairy industry's trucking facilities. With the exception of small areas in southeastern New Hampshire, truck routes and producer locations have been mapped.

The significance of a possible elimination of waste already has been proven in the Colebrook area as set forth in Experiment Station Circular No. 65. "The Colebrook Plan" was developed by a local committee which was set up at a conference called by the Public Service Commission. Final approval and effective administration of this plan by the Office of Defense Transportation indicates the possibilities of local planning to eliminate waste. In this area 330 truck miles and 50 man hours are saved daily. It is estimated that approximately 40 per cent of the truck mileage can be eliminated in most collection areas.

H. C. Woodworth, J. C. Holmes, D. Hosken

Egg Transportation

How eggs reach market, and the possible adjustments in line with necessities of war, are two objectives of this egg transportation study now in progress.

Six carriers with 52 routes truck the bulk of New Hampshire eggs which pass through jobbing or wholesale channels. Three of the carriers operating 29 routes average from 65 to 140 miles per route, pick up from 1.1 to 2.2 cases per mile, and make from 15 to 34 stops per 100 miles. Hatching eggs constitute a significant proportion - 40 to 60 per cent - of all eggs handled. Hatching and market eggs are not usually picked up on the same trucks. Greatest possibilities for savings appear to be:

(a) Eliminate routes on which there is a small poultry population
(b) Have reciprocal arrangements for pick-ups in sections where flocks are scattered.
(c) Handle both hatching eggs and market eggs on the same truck when feasible
(d) Have small producers who are less accessible leave eggs at farms on main routes or at designated points which will facilitate pick-ups

L. A. Dougherty

Economies in Purchases Made by Farmers

Although war conditions reduce the opportunities for savings in making purchases, there should be no relaxation in efforts to realize legitimate savings. Even greater attention needs to be given to quality, and there is an ever-widening variation in values due to substitutions, and to difference in prices of prewar and war goods.

The list of fertilizers offered has been reduced, but it is found that savings are still available through advance orders and cash purchases, and by purchases in ton or carload lots.

Savings in the purchase of feed are not as readily available because of increased demand and reduced supply. Farmers should continue to scrutinize values carefully and not adopt the "get it at any price" psychology.

The first publication will be on "Purchasing Fertilizers."

L. A. Dougherty, D. Hosken

AGRICULTURAL ENGINEERING

Potato Storage Construction

This project was continued, using three bins each holding about 300 bushels of potatoes. All were equipped with flues leading to the bottom of the bins to permit the entrance of cool air for fall cooling, and to provide for an outlet to remove the warm air from the top of the bins. There also was provision for recirculation of the air within each bin after the desired temperature of 40°F. had been reached. Loss of weight was noted for the bottom, center, and top of each bin.

Little difference in loss of weight was evident between the bin equipped with a central flue at the bottom and the bin in which the entire bottom was constructed of slats. Two recommendations are apparent:

(1) Cool the bins in the fall by causing cool air to pass under and up through the potatoes

(2) Have flues at the top to carry off the warmer air

Two of the bins were constructed so that fall cooling was obtained by natural draft or gravity and the other was obtained by use of a suction fan. The suction fan cooled the bin to the desired temperature in about ten days, whereas the gravity method required four to five weeks. After the bins were cooled to the desired temperature (38°F. to 40°F.), the flues were closed to exclude outside air. However, each bin had a false partition in the back to circulate the same air within the bin.

The bins cooled by gravity had a smaller loss of weight than the one cooled more rapidly by suction fan. This shows that as long as the potatoes in the bin can be cooled in four or five weeks, the results are satisfactory. The average weight loss for gravity-cooled bins was 1.79 per cent and for the bins cooled by suction fan the loss was 2.81 per cent. Obviously, it is important to cool the bins, but rapid cooling with rapidly moving air tends to dry the potatoes. Further evidence that outdoor air has a drying effect is the fact that potatoes at the bottom of each bin had a greater loss of weight than those at the top of the bin.

The storage period covered in this experiment was from five to eight months. The tubers selected were free from bruises. Length of storage period had little effect on the loss of weight, provided that the potatoes were cooled reasonably soon to about 38 or 40°F. and held as near that

temperature as possible. The following table gives the weight losses at different positions and for different types of bins:

The Per Cent Loss in Weight According to Position of Potatoes in the Three Bins

Bin	Period in months	Method of cooling	Position in bin		
			Top	Center	Bottom
A	5	Gravity	0.63	3.30	2.70
B	8	Gravity	0.21	2.50	2.40
C	6	Suction fan	1.01	2.88	4.84

Another test using injured and uninjured tubers stored in crates while in storage so that there was free circulation of air around each crate was conducted. The uninjured potatoes lost 3.08 per cent of their weight and the injured lot lost 5.68 per cent during eight and one-half months of storage.

P. T. Blood

The Homemade Power Wood Saw

Stimulated by the interest in fuelwood resulting from the threatened shortages of oil and coal for heating purposes, the Director designed and constructed a wooden frame by means of which a small electric motor or a gasoline engine of fractional horsepower weighing less than 50 pounds could be attached to a one-man crosscut saw. Presumably, this equipment is adapted to cutting large logs in the woods in preparation for fireplace or furnace. Some 10 cords of wood comprising, maple, oak and elm from 6 inches to 3 feet in diameter were sawed in two-and four-foot lengths. The whole apparatus is mounted on a sled. Where the snow is not too deep it can be rather easily hauled to new positions by one or two men. It was loaded in a light trailer behind a touring car for Saturday afternoon trips to the woodlot. After a little more perfecting, some descriptions and illustrations may be made available in mimeographed form.

M. G. Eastman

Buck Rake Construction and Use on New Hampshire Farms

According to the county Farm Bureau agents, the current labor situation has caused many requests concerning the "buck or transport rake" as a time and labor saver. The construction and use of this type of haying implement is being experimented with at the university farm.

Because of its relatively long wheel base and heavy engine necessary for counterbalancing the weight of the loaded rake at the rear, a 1931 Buick sedan was selected for the power unit. The rake itself was constructed according to the Ohio plan with a few adaptations made necessary by available materials and by the frame construction of the power unit. The rake was attached to the power unit by construction of a hinge, using a ¾-inch pin.

A power-driven hoist was contrived by making use of an automobile starter, a fly wheel, a transmission, and a winding drum made from a piece of 3-inch pipe. In the field trials that have been made this hoist will

lift the load but it has proven subject to rather serious difficulty such as excessive drain on the battery and failure of the starter to disengage. A power-driven hoist is a necessary time saver and further experimenting will be continued on this mechanism by making a direct connection through some part of the engine or final drive.

Time trials are to be conducted during the 1943 harvest season in order to determine the amount of time and labor saved by use of the buck rake. A publication showing construction details and other pertinent information will be available to New Hampshire farmers in time to construct a similar rake for their own use on the 1944 hay crop.

E. W. Foss, P. T. Blood, M. F. Abell

DAIRYING

Breed Analyses of Herd Management Practices

A study of the lactation records of more than 4000 cows owned by farmers who are members of the New Hampshire Dairy Herd Improvement Association has been continued. The study involves five breeds of dairy cattle including (in order of number of cows) Holstein, Guernsey, Ayrshire, Jersey, and Milking Shorthorn. The data were tabulated to facilitate a statistical analysis for each breed on the basis of twelve distinct comparisons involving production, date of freshening, length of lactation, grain-milk ratio, and age.

Conclusions based on completed analysis indicate breed differences in the response of dairy cows to certain management factors. For instance, in studying the influence of the calving month on production, Jerseys showed no significant relation between these two factors, whereas the other four breeds gave a picture resembling that commonly found by other investigators, with the midsummer freshening causing lower lactation yields and late fall and winter freshenings in higher yields. Environmental changes brought about by seasonal variations did not influence milk production with Jerseys as it did with other breeds.

In comparing the length of lactation with milk production (4 per cent F. C. M.), Holsteins showed greater response in milk yield to longer lactation periods than did the other breeds.

Another indication of breed differences was observed as a result of comparing the milk-grain ratio with the yield of milk (4 per cent F. C. M.). Ayrshires, Guernseys, and Holsteins showed positive correlation between increased production and a widening ratio of milk to concentrates, whereas Jerseys showed a negative correlation.

The length of lactation was not influenced significantly by the month of freshening.

In studying the effect of the month of calving on the ratio between the grain fed during lactation and the lactation milk yield, the freshening months of June, July, August, and September each showed low returns of milk for grain fed for at least four of the five breeds studied. For July, calving comparisons were significantly low, and in August four were significantly low. Greatest returns of milk in relation to amount of grain

used, tabulated on the basis of month calving, were found in January and February with Ayrshires, January and March with Jerseys, and March and May with Holsteins. No significant relation was evident in the case of Guernseys and Milking Shorthorns.

Dry periods longer than 90 days did not result in increased milk yields for the subsequent lactation.

Grain feeding during the dry period varied greatly between breeds. With Jerseys, 50.4 per cent of the cows were fed an average of only 25 pounds of grain during the dry period in contrast to 23.9 per cent for Ayrshires, 28.2 for Guernseys, and 13.2 for Holsteins.

Correlations between the amount of grain fed during the lactation period and 4 per cent F. C. M. produced were as follows: Ayrshire .688 ± .02; Guernsey .476 ± .029; Holstein .787 ± .00875; Jersey .689 ± .0249; Milking Shorthorn .816 ± .0259.

K. S. Morrow, H. A. Keener

Dry Rations for Raising Dairy Calves and Heifers

Nineteen calves have been fed three different dry calf rations during the past year. Fluid milk consumption was held to a minimum in each instance. A ration containing fish meal and dried whey as the sources of animal protein gave as good results as the university dairy herd calf ration, to which 25 per cent of powdered skim milk had been added. The dried whey seemed to have a beneficial effect on bowel disturbances. When ¼ pound of dried whey was added daily to the milk of calves with diarrhea, beneficial results were obtained.

During the past year, determinations of sugar, phosphorus, and calcium were run on calves' blood at intervals of approximately every two weeks by the department of Agricultural and Biological Chemistry. The Klett-Summerson photoelectric colorimeter was used in the sugar (Folin and Wu) and phosphorus (Fiske and Subbarow) methods using oxalated blood filtrates, while the calciums were run on serum by the Clark-Collip modification of the Kramer-Tisdall method. Analyses of the calves' blood for calcium, inorganic phosphorus, and glucose did not show a significant relation to the kind of ration fed. The lack of difference for calcium and inorganic phosphorus was particularly interesting due to the fact that while the ration containing skim milk contained one per cent steamed bone meal, the fish meal-dried whey ration contained no mineral supplement. The high mineral content of the fish meal, along with its vitamin D content, and the fairly high mineral content of the dried whey, apparently eliminate the need for the addition of a mineral supplement in rations similar to the one used in this experiment.

Present work on this project involves the testing of a dry calf ration which contains no animal protein. This change was made because of the increasing scarcity of animal and marine proteins. This ration is being fed in conjunction with a limited amount of milk. Milk feeding was reduced, with the total amount spread over a longer period of time. Although no calves of this group have finished the five months' feeding period as yet, the results so far are very promising. This phase of the work is being continued with a more extended investigation of the effects of the ration on the vitamin and mineral content of the blood. It is also

planned to compare the utilization of rations both with and without animal protein by means of digestion studies.

K. S. Morrow, H. A. Keener, S. R. Shimer, N. F. Colovos

Improving the Solids-Not-Fat Content of Milk by Selective Breeding

During the year three additional sires were proven, making a total of thirteen: eight Holstein, two Jersey, one Guernsey, and two Ayrshire. New lactation records were added for the ten sires proven during the preceding year, and five of the sires were reproven by adding more dam and daughter comparisons.

Nine sires increased milk production, four decreased milk production; five lowered fat percentage and eight increased the fat test; nine increased the percentage solids-not-fat and four lowered the percentage solids-not-fat. Placing the sires in groups according to fluctuations in the factors, milk production, percentage butterfat, and percentage solids-not-fat (Ex.: + milk, - per cent fat, + solids-not-fat; + milk, - per cent solids-not-fat, etc), and averaging the figures the following results were obtained: two sires: + 1975 lbs. milk, - 0.05 per cent fat, + 0.11 per cent solids-not-fat; two sires: + 1174 lbs. milk, - 0.16 per cent fat, - 0.08 per cent solids-not-fat; two sires: + 683 lbs. milk, + 0.05 per cent fat, - 0.09 per cent solids-not-fat; three sires: + 467 lbs. milk, + 0.19 per cent fat, + 0.21 per cent solids-not-fat; one sire: - 19 lbs. milk, - 0.17 per cent fat, + 0.19 per cent solids-not-fat; three sires: - 898 lbs. milk, + 0.28 per cent fat and + 0.27 per cent solids-not-fat.

These results indicate that the three factors, milk production, percentage butterfat, and percentage of solids-not-fat, may be inherited separately, and that it is impossible to predict the change in solids-not-fat from the change in per cent fat.

H. C. Moore, H. A. Keener

Studies of Bovine Mastitis

The effectiveness of segregation for the control of streptococcic mastitis has been studied over a five to six-year period in ten experimental herds. Samples of milk from all cows in these herds were examined by laboratory tests for mastitis and the infected cows in each herd determined. Tests were then made at intervals of three months to check on the spread and incidence of the infection in each herd. Two herds were established as streptococcic mastitis free; segregation of the infected cows was practiced in six herds; and in two herds no attempt was made to segregate the infected from the mastitis free cows. In the segregation procedure, all the mastitis cows were placed at the end of the milking line or on one side of the barn and these animals were always handled and milked last.

In the two herds that were established as streptococcic mastitis free, no new infections occurred due to *S. agalactiae*, the organism causing contagious mastitis. One of these herds has remained free for a four-year period and the other for a five-year period. While the incidence of mastitis infection was appreciably reduced in the six herds practicing segregation, it was not possible to control completely the spread by this meth-

od alone. It appears necessary to eliminate the infected cows as rapidly as possible by disposal or by treatment with selected drugs. In the two herds where no segregation was used, the infection continually spread to new cows and it was not possible to reduce the number of infected cows in these herds.

Studies on the treatment of streptococcic mastitis were continued using sulphanilamide, novoxil, and tyrothricin, nineteen cows were treated with sulphanilamide in oil during lactation; 11 or approximately 58 per cent were cured. Two cows were treated with sulphanilamide one week after drying; both cows were cured. Twenty-four cows were treated with novoxil during lactation; 16 or 66 per cent were cured. Thirty-four cows were treated with novoxil 10 to 21 days before calving; 17 cows or 50 per cent were cured. Ten cows were injected with tyrothricin in oil; five cows or 50 per cent were cured.

It is evident that streptococcic mastitis can be cured if proper drugs and methods are employed. However, it was found that acute cases and long-standing chronic infections may not respond to treatment. Better results can be obtained when cows are treated late in lactation or about three weeks before calving. Novoxil was found to be irritating to the mammary tissues, milk of lactating cows cannot be used for at least 10 days after treatment. Eight quarters out of 142 with novoxil dried after treatment. Studies on the efficiency and use of these agents for the treatment of mastitis are being continued.

L. W. Slanetz, F. B. Allen, A. J. Shanahan

Chore Practices in Dairy Barns

Due to the acute farm labor shortage and because daily chores absorb a surprisingly large proportion of man labor on New Hampshire dairy farms, the economy of routine practices demands current interest. The first phase of this project is focused on the use of the milking machine, the function of which is to save labor. Observations and time records have been made on 32 dairy farms and involving a total of 772 cows. The average machine operation per cow per milking ranged from 3.48 minutes to 9.58 minutes, an average of approximately six minutes per cow. In some instances, farmers were attempting to do other chores while the machines were operating and too frequently left the milkers to long operation and have thereby lengthened the daily necessary chore period. It is believed that the average time should not exceed 4 minutes per cow per milking.

Observations indicate rather definitely that many farmers do not watch the milking operations closely and that their cows are not trained to habitual rapid milking. It is obvious that some machines need overhauling, and that more rapid milking can be obtained through a periodical renewal of rubbers. Whereas some farmers were consistent in the amount of time consumed per cow over a period of several milkings, others were inconsistent and the time fluctuated considerably from milking to milking.

H. C. Woodworth, K. S. Morrow

FIELD CROPS AND FERTILIZERS

Rotation, Fertility, and Cultural Experiments With Potatoes in Northern New Hampshire

This project, located on the Coffin farm, near Colebrook, was continued during the past year. However, due to the difficulties of securing nitrogen carriers, it was necessary to omit the comparison of these carriers as a factor in potato production. A test of the need for more calcium was substituted for this phase of the work.

Accordingly, gypsum was secured and applied broadcast at three rates, 500, 1000, and 2000 pounds per acre. The land was harrowed thoroughly and potatoes were planted with uniform fertilization. At harvest time, yields for the different treatments were as follows:

Application of gypsum	Yield per acre	Increase over no gypsum	Increase for each added application
None	323 bu.		
500 lbs.	364 bu.	41 bu.	41 bu.
1000 lbs.	399 bu.	76 bu.	35 bu.
2000 lbs.	411 bu.	88 bu.	12 bu.

Although the results represent but one season's work, they are sufficiently significant to indicate that calcium or sulphur, or both, are seriously deficient on this soil. The work is being repeated in 1943 to see whether similar results are obtained, in which event the need for an expansion in the use of gypsum as a soil amendment in the Colebrook area, and perhaps on other potato soils of the state, would seem apparent.

Yields resulting from the use of gypsum vary more widely than those for different fertilizers. Because of the dry weather the season at Colebrook in 1942 was not ideal for potatoes and yields were about 25 per cent below normal. With such a season, differences in yields due to fertilizer variable are usually pretty well ironed out. This was the case in 1942.

The table below gives the average yields for various fertilizer treatments from 1940 to 1942 inclusive. In these treatments, nitrogen was kept at a constant level, while the phosphoric acid and potash were varied. Yield variations for these treatments are so slight as to be well within the limits of error.

Fertilizer Formula	Results for fertilizer variables, 3 yr. average		
	Amounts	Ratio	Yield per acre
5-10-10	1600 lbs.	1-2-2	337 bu.
4-12-12	2000 lbs.	1-3-3	343 bu.
4-8 -16	2000 lbs.	1-2-4	343 bu.
4-16-8	2000 lbs.	1-4-2	335 bu.
4-16-16	2000 lbs.	1-4-4	346 bu.
8-16-16	1000 lbs.	1-2-2	331 bu.

With potatoes showing a rather remarkable response to gypsum, it is quite likely that the need for calcium (or sulphur) is so strong on this field that variations in amounts of other plant foods are overshadowed.

This is a question that should be more apparent after another year or two of experimenting.

Yields of potatoes in the placement test were at variance with previous results. In 1942, there was apparently no advantage in drilling fertilizer, as that which was broadcast gave slightly better results than other placement methods. This fact agrees with work done in other years and in other trials, and while there is an apparent advantage from banding, there is an occasional year when this is not the case. The 1942 season happened to be such a year.

The three-year-average yields for the fertilizer placement test on this field follow:

Method of placing fertilizer	Yield per acre
Broadcast	275 bu.
N & K broadcast, P drilled	259 bu.
N broadcast, P & K drilled	265 bu.
All banded	301 bu.

Even with the seemingly adverse results in 1942, when potatoes grown by broadcasting fertilizer outyielded those in any other treatment by 28 bushels per acre, the three-year average still shows an advantage for banding with the planter.

Three rotations are in progress on this field, and soil studies are being run coincidentally with the fertilizer work. These rotations represent potatoes continuously with no cover crop, and also in a two- and in a four-year rotation. Cover crops are being utilized in the two-year rotation. Soil structure studies and organic matter determinations will be made on samples collected at the beginning and at the end of a five-year period.

The department of Agricultural and Biological Chemistry grew potatoes in the greenhouse at three different levels of available calcium. With the particular soil used, applications of gypsum did not significantly increase the potato yield. Evidently there was enough available calcium in the soil of the check pots to satisfy requirements.

F. S. Prince, P. T. Blood, G. P. Percival

A Dairy Farm Rotation Experiment in Southern New Hampshire with Sweet Corn as a Cash Crop

This project was continued during 1942 and the findings were reported in an Experiment Station circular now available for distribution. Deductions from the circular appear below in way of summary.

Larger yields of sweet corn were produced with manure, properly supplemented, than with fertilizers alone, although the amount of plant food actually applied in the manure treatments was much greater.

Amounts of fertilizer up to 1000 pounds per acre were found to be profitable in this test, where no manure was used. The fertilizers used were of the 4-8-4 and the 4-16-4 formulas. Larger amounts were not tried, but with sweet corn values at $20 a ton, or more, at canning factories, or on market-garden farms with corn at more than ten cents a dozen, more fertilizer than this can safely be recommended.

With small amounts of fertilizer, a high-phosphorus formula proved to be slightly superior, but with larger amounts the choice of a formula became less important. If the data for side-dressing as well as amounts of fertilizer are taken into consideration, it would seem advisable for high yields to use a ratio narrower than a 1-4-1 when applying large amounts of material.

Fifteen tons of manure, supplemented with 400 pounds of superphosphate, produced almost as much sweet corn as a 30-ton application supplemented in the same manner. It is quite obvious that in using as much as 30 tons of manure in one application some of its plant food value is subject to waste.

The use of superphosphate in suitable amounts as a supplement to manure proved to be a good practice, although the results here reported do not seem to indicate the need for more than 400 or 500 pounds of 20 per cent superphosphate.

In addition to manure and superphosphate, 200 pounds of 4-12-4 applied in bands with the corn planter paid good returns. This small amount of complete fertilizer apparently acted as a starter and kept the seedlings growing until their roots reached through the soil for the manure and superphosphate which had been broadcast.

A planter application of a complete fertilizer had a material effect upon hastening the maturity of sweet corn in this test.

The results of side-dressing with Chilean nitrate of potash are not too conclusive, and the economy of the practice apparently was governed by the amount and formula of the fertilizer previously applied. With a wide fertilizer ratio, such as the 1-4-1 or 4-16-4 formula, a greater increase was obtained than with the 1-2-1 ratio. This, no doubt, relates to the balance of the total nutrients applied. August rainfall had much to do with the effectiveness of side-dressing in this experiment, a wet August being favorable for this practice.

General conclusions or recommendations based on three years of experimenting may be summarized as follows:

1. If no manure is applied directly for sweet corn, or if the land has not recently been manured, at least 1000 pounds of a 20-unit fertilizer may be applied with good results.

2. If manure is applied, it should be used in amounts of 15 tons per acre of cow manure or 10 to 12 loads of poultry manure. An application of manure should always be supplemented with 400 to 500 pounds of superphosphate. A planter application of a good corn fertilizer in amounts of from 150 to 300 pounds should also be made at planting time.

3. On land that has been heavily manured during the year preceding corn, a broadcast application of 400 pounds of 20 per cent superphosphate, in addition to a planter application of from 250 to 500 pounds of a good corn fertilizer, should give excellent results.

F. S. Prince, P. T. Blood

The Relation of Potash Levels to the Persistence of Clover in Hay Stands

Previous investigations in this area of research on the Livingston farm in the Connecticut valley have been reviewed in Circular 61, April

1942, "Fertilizer Needs of Dairy Farm Crops in the Connecticut Valley." The objective of the present project is to determine the various levels of potash in the soil and their relation to the persistence and longevity of clovers in existing hay stands. This work adds continuity to previous research inasmuch as clovers have persisted in all potash-treated plots regardless of the application of other fertilizer elements.

The field has been divided into two sections; the first contains plots 1 to 46 and the other contains plots 47 to 80. The former groups have been plowed and reseeded with different levels of manure on certain plots which will also be top-dressed with varying amounts of potash. The latter section, plots 47 to 80,was left in sod which was seeded in 1937 and has been harvested for four consecutive years, 1938-1941. Some of these plots exhibited a considerable amount of red clover particularly those which had received an annual top-dressing of potash either alone or in combinations with other fertilizer ingredients. In some instances treatments have been modified on these plots to see if, by treating with potash, clovers could be encouraged in the hay stands. Treatments on other plots have been continued as in previous years and some of the check or untreated plots were allowed to remain for contrast. These plots were harvested once during the 1942 season. The average yields for the various series follow:

Four years' results, 1938-41		Results for 1942		
Treatment	Average yield in pounds per acre*	Treatment	Amount of fertilizer in pounds	Yield in pounds per acre
1. Ch	2290	Ch	None	1460
2. Ch or L.	2240	K	125 Kcl	1682
3. LK	4560	K (old)	125 Kcl	2492
4. LP or LM.	2780	0-20-20	400 0-20-20	1932
5. Ch orL.	2240	8-16-16 + K	500 8-16-16 + K	4257
6. M or MP	2998	8-16-16	500 8-16-16	4571
7. LPK	7036	PK	400 0-20-20	5203
8. LNPK	6958	NPK	500 8-16-16	6113

* Yields taken from Circular 61.

Of these treatments, four were unchanged because the lime (L) which appears in the list of former treatments was applied only once and that in 1929. The yields as shown by the records indicate that those plots receiving superphosphate and complete fertilizer held up very well in 1942, clover still persisting in the stand. Potash alone (3) shows a gain of about one-half ton of hay over the check plot average. Applying potash to former check or lime treatments (2) did not stimulate yields as much as did the annual application of potash, as in treatment 3.

The most interesting changes are shown in treatments 5 and 6. In 5, changing from a system of no top-dressing to one containing a complete fertilizer with extra potash, the yield as shown by the four-year average, 2240 pounds, was increased to 4257 pounds in 1942. Potash alone in treatment 2, used on similar plots, brought the yield only to 1682 pounds.

This would seem to indicate that with normal fertilizer supplies fertilizers could often be substituted for tillage in maintaining hay yields.

In treatment 6, plots which had been treated with manure in 1936 and half of which had received an annual application of superphosphate, a change in treatment to a complete fertilizer raised the yield from an average of 2998 pounds to 4571 pounds per acre. Of equal significance is what happens to the stand. If top-dressing will induce clovers to volunteer in the stand for the 2, 4, 5, and 6 treatments, where no clover existed prior to the change in treatments, there is evidence that a big step has been taken toward a grassland farming system.

The department of Agricultural and Biological Chemistry continues to cooperate in this new project. Greenhouse comparison of potassium metaphosphate and nitrate of soda with an equivalent amount of potassium chloride, 20 per cent superphosphate and nitrate of soda was continued with second, third, and fourth crops of corn grown without additional fertilizer treatment. The second crop showed that both treatments gave significant increases over the check, but did not differ significantly from each other. The third crop gave no significant difference, either between treatments or treatments and check. However, the potassium metaphosphate plots showed less potassium deficiency. The fourth crop, still growing, showed about equal amounts of potassium deficiency on all pots with the poorest growth on the check plots.

Soil samples were taken by levels from some of the field plots in order to determine the potash levels. Near virgin soil was taken from outside the plots and hybrid corn was grown in the greenhouse in gallon pots. Equivalent amounts of postassium chloride, potassium sulphate, and potassium metaphosphate were compared with an equivalent amount of complete fertilizer. Potassium deficiency was apparent in all plants, but both the sulphate and metaphosphate samples gave significant increases in dry matter over the check plots.

F. S. Prince, P. T. Blood, G. P. Percival

Variety Trials with Small Grains in Northern New Hampshire

Variety tests with oats were continued in 1942 on the Coffin field which is under lease by the Experiment Station and is representative of farmlands in northern New Hampshire. Based on data from the 1941 test, the better varieties were retained and the poorer, or those which showed no promise, were discarded, and new varieties were introduced. Notes were made on yields and growth characteristics of each variety particularly lodging, state of maturing, shattering, and condition of straw.

A few varieties which rank particularly high in yield in 1941 also yielded well in 1942. The difference between the lowest and highest yielding varieties in 1942 is approximately equal to the difference in 1941. The wide spread in yield noted both years indicates the importance in choosing an oat variety. It is quite possible that the elevation (1700 feet) has considerable influence on the behavior of the different varieties.

Oat variety tests are being continued in 1943 with the view of having co-operative farmers in this area multiply seed of the Upright and Erban oat varieties.

Barley varieties have not proven as adaptable to this area as have the oat varieties. The Wisconsin 38 variety failed in both 1941 and 1942, and Alpha failed in 1942.

P. T. Blood

Corn Variety Trials

Corn variety trials are stationed at the Whenal farm in Greenland in southeastern New Hampshire. There are three classes of trials; flint corn for grain, dent hybrid corn for grain, and silage corn.

1. Flint Corn for Grain

Twenty local varieties of flint were planted on May 15, 1942. There were three randomized plots of each variety, and 22 hills in each plot. Each hill was thinned to three stalks in order to maintain a near perfect stand.

On October 15, ears were picked from each plot and weighed. Twelve ears were picked at random from each flint sample and then dried to a uniform moisture percentage of approximately eight per cent. Using the moisture correction, yields were calculated on an equal basis.

In 1941, 19 local flints were tested, 18 of which were repeated in 1942. In general, those varieties which gave good or poor yields in 1941 repeated their relative position in the yield table for the 1942 season. The average yield of the two seasons ranged from 39 bushels to 56 bushels. Whereas some high yielding varieties showed good maturity, others were too immature to recommend as a good corn for grain in this area.

2. Dent Hybrid Corn for Grain

Twenty-two dent hybrid strains of corn for grain that showed some promise for New Hampshire conditions were field tested in 1942 for adaptation. These samples were grown and harvested in the same manner as were those of flint corn. The yield per acre ranged from 45 bushels to 77 bushels and averaged 58 bushels, which is slightly less than New Hampshire 500, a selection from Minnesota 13 that has been grown in southeastern New Hampshire for several years. Minnesota 700 yielded 64 bushels per acre, matured very early and had the least weight loss as a result of drying. This hybrid shows considerable promise. These variety trials are being continued in 1943.

3. Silage Corn Trials

During every year since 1936, a number of silage corn varieties, including numerous new hybrids, have been tested for comparative adaptation. Each year the better varieties have been continued and the poorer ones have been dropped. During the 1942 season 22 varieties were tested in such a manner that each was replicated three times in plots of 22 hills thinned to three stalks per hill. Twelve hills from each plot were green weighed and one hill was bagged and dried for weight calculations on a uniform basis. As a result of repeated trials, three varieties show considerable promise; namely, West Branch Sweepstakes, Lancaster Surecrop, and Cornell 29-3.

L. J. Higgins

Advanced Alfalfa Nursery Trials

In 1941, two varieties and four new trials of alfalfa were planted at the Whenal Farm, Greenland, New Hampshire. Each of the alfalfas were replicated five times in randomized plots. During the following season, 1942, there were three harvests. In each instance the three middle rows of each plot were cut and weighed green and the two outside rows were discarded. The per cent dry matter was calculated from randomized samples and dried in a steam-heated drier.

Grimm gave the largest yield, 3.94 tons, and Michigan A-99 the least, 3.69 tons, a range of only .25 tons. The resulting yields in tons per acre follow in descending order:

1.	Grimm	3.94	4.	A-67 N. J.	3.79
2.	A-145 N. J.	3.92	5.	Dakota Common	3.77
3.	A-68 Mich.	3.89	6.	A-99 Mich.	3.69

L. J. Higgins

FORESTRY

Propagation of Sugar Maples

During the spring of 1943 some 60 trees were tested in eight towns in various parts of the state. Five different sugar places were visited, and the project was discussed with a number of operators. Random sampling was tried on three different occasions, and the results were so unsatisfactory that efforts were confined to those trees reported by operators to be somewhat sweeter than the average. This was the plan followed in visiting other parts of the state.

The sugar content for 48 of the 60 trees tested was between 3.0 and 5.9 per cent of the sap. In two instances, the sugar content was below 3.0 per cent and in one instance it was above 9.0 per cent.

It will take at least another season to determine whether or not high-testing trees are really as sweet as present figures indicate. It is also planned to carry on a series of daily observations to determine the effect of weather on the sugar content. Statements of different operators do not agree.

The plant physiologist of the station has taken cuttings from a number of the better trees and will use them for propagation experiments.

Seeds were collected from two trees on the campus in the fall of 1942, and 27 tests of the results of different methods of storage were carried on during the following winter and spring. Preliminary results indicate that it may not be possible to break down the rest period of apparently four to six months required by sugar maple seeds. Temperature, moisture, and time are the three elements involved. Temperature requirements are not yet clear, but it is probable that seeds should be kept below 40°F. during most of the winter. Present tests do not give sufficient data on this point. It also appears that a certain amount of moisture must be present for the seeds to germinate successfully soon after planting. Although many of the seeds stored over winter, under conditions in which they did not pick up any moisture, seemed to have retained their viability, as indicated by

Fig. 1. Maple Seed Storage Experiment. Shows weather recording instruments as well as method of storing seeds in cloth bag, in bucket of sand, under leaf litter, and stratified under two feet of sand.

cutting them open, none of them germinated during the 50 days of the test. On the other hand, seeds stored in the ground where they were able to absorb a considerable amount of moisture, (as indicated by their change of weight), germinated rather readily and, in fact, some of them had already started to germinate when they were dug in the spring.

Figure 1 shows the storage experiment set up outdoors. The seed frozen in ice and those kept in tight jars were stored in the cold rooms of the poultry department.

Present indications are that 1943 will not be a seed year for the sugar maples in Durham. If, however, a supply of seed can be located next fall, it is planned to conduct another series of storage tests designed to determine somewhat more definitely the conditions necessary for satisfactory storage of these seeds. As a result of the season's tests, it ap-

Fig. 2. Sugar Maple cutting showing type of roots produced after three months in cutting bed. June to September, 1942

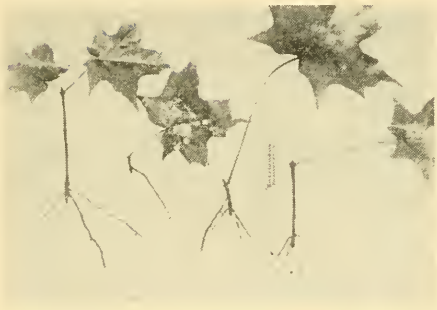

Fig. 3. Sugar Maple cuttings showing rooting of various sized cuttings after three months in cutting bed June to September, 1942

pears likely that stratification in sand at a depth of two feet gives much the best results.

Cuttings from sugar maples of ages varying from 10 to 100 years were treated with different growth-promoting substances. They were placed in two types of beds: (a) outdoor, covered with burlap, and (b) in a shaded sash-covered bed located in a shaded greenhouse. Both were watered twice daily in fair weather. Two types of rooting media, sand plus peat and sand only were used. Cuttings were treated with indolbutyric acid solutions, Rootone, and water only. They were taken from the current season's growth.

Indoors carefully shaded, moisture-retaining beds were considerably better than outdoor beds covered with burlap only. As maple leaves are very sensitive to a dry atmosphere, it is important to keep them moist.

The best time for gathering the cuttings is early in June. No advantage is obtained from hormone treatments, as higher percentage of rooting were obtained in general from those treated with water alone. There was considerable variation in rooting by cuttings from different clones. Age of clone did not seem to matter particularly. One old clone gave rooting as high as 53 per cent. Average percentages of rooting of all treatments based on a total of about 2,000 cuttings were as follows: water only, 18 per cent; Rootone, 15 per cent; indol-butyric acid, 14 per cent.

C. L. Stevens, Stuart Dunn

1942 Plantations

Series	No.	Area in acres	Species	Survival Per cent	Average Height	
					1942	1943
B	20	.61	Norway Spruce	95	.65	.78
	21	.88	White Pine	95	.60	.74
	22	.13	Red Birch	41	.75	1.22
	23	.63	Mixed Hardwoods	84	.36	.40
	24	.07	Red Oak	20	.15	.16
C	2	Line	Black Alder & Service Berry	70	.23	.29
D	16	.10	Red Birch	70	.88	1.15
	17	.10	Service Berry	73	.29	.24
	18	.10	Norway Spruce	95	.63	.73
E	2	—	Red Oak	2	Seeds	.31
	3	—	Silver Maple	38	Seeds	.69

Plantation Studies

The annual spring examination was made and the growth and survival measured for the various series of plantations under investigation. The severe weather during the 1942-43 winter appears to have had its greatest effect on the hardwoods; as a result a number of sample trees have their tops killed back. Since the growth was measured to the height reached during the preceding fall, the effects of this winter killing will not be apparent until next year's measurements are taken.

Nine new plantations were established during the spring of 1942, as well as two direct seeding experiments. A summary of these plantings is given on page 28.

In the study of sprout reproduction, one series of 50 stumps was numbered last spring, and the sprouts were measured at the end of the growing season. The results are as follows:

Sprout Growth During 1942 By Species

Species	No. of Stumps	Ave. No. of Sprouts per Stump	Height of Sprouts in Inches	
			Average	Maximum
Gray Birch	1	44.0	40.0	56
Black Birch	2	00.0	—	—
Shagbark Hickory	3	4.0	15.6	31
Red Maple	6	17.2	27.3	62
White Oak	9	24.7	24.0	56
Black Oak	12	36.6	28.6	54
Red Oak	17	34.1	29.5	72

These stumps were all from trees cut during the winter of 1941-42. It is planned to establish further series on areas cut over in the winter of 1942-43, in order to get a better and more even representation by species.

Twenty-two species of seeds were collected and tested, most of which have been planted in the nursery to supply seedlings for future plantations. For each variety, notations have been made as to the weight of 1000 clean seeds in grams, the per cent viability by cutting, the number of days to first germination and the percentage germination at the end of 50 days.

An experiment to determine the possibility of collecting freshly germinated hardwood seedlings was started during the past year. A number of very young seedlings of basswood, beech, and Canada plum were collected in the woods and brought to the nursery where they were set in the seed-beds. The survival thus far has been reasonably good and warrants further study. The practical value of this project lies in the fact that the seeds of many hardwoods are rather difficult to store. If collected in the fall and kept over winter a large proportion of them are not likely to germinate when planted in seed-beds. If these newly germinated seed-

lings can be collected in the spring and set in the nursery with a low mortality, it may prove to be the best procedure for handling species difficult to store or slow to germinate. Considerable work is necessary to determine the proper technique of handling, the probable per cent of survival, and relative expense of handling the various species. A possible alternative is that of moving these plants directly to their final site, eliminating the period in the nursery, and thereby reducing the cost of regenerating an area. A very limited test on red oak gave poor results last season, but there is no reason to believe that such a procedure cannot be successfully and cheaply carried out. During the coming year it is planned to develop the details of a more comprehensive experiment on this type of plantation.

C. L. Stevens

White Pine Stands

Last year was not a seed year for white pine in this locality, and therefore nothing was added to the study of seed production on the established plots. One plantation of white pine was established in the spring of 1943, and this represents the extent of work on this project due to labor conditions. Some attention will be given to the development of a better strain of white pine during the coming year. There are now in the nursery 4-year-old transplants raised from seed collected in Michigan and in northern New Hampshire. These trees will be kept separate when planted and their growth and development compared with each other and with a local strain. Each of these groups is apparently somewhat more vigorous than the average run of white pine transplants raised in our nursery. If they are able to maintain this superiority after being set out on the poor sites afforded in our university woodland, it will be an excellent indication that something can be done about improving our stands of white pine.

C. L. Stevens

Spruce Reproduction

Due to war travel conditions, the plots in northern New Hampshire were not visited during the past year.

It appears that the problem of securing satisfactory spruce reproduction may be one of exposure of the young seedlings to adverse weather conditions. About 40 years ago a special cutting system was developed in Europe to secure better survival in naturally seeded areas of Norway spruce. The fundamental feature of this new system was the protection given the young trees against the direct rays of the sun and against drying winds, which might tend to kill most of the young and tender seedlings during the first summer. There are no experiments known to the leader of this project for testing the results obtainable by the use of such a system. A visit to a large number of cuttings throughout northern New Hampshire might give evidence to justify the assumption that our native spruce would respond to this type of treatment. The best alternative is to experiment in the nursery in order to test the effect of better protection on young spruce seedlings. Such a test is planned for the coming year.

C. L. Stevens

The Supply of Low Grade Wood for Plastics

The major objectives of this project are to determine the amount and location of low grade wood and timber, and of manufactured mill waste, available for conversion into plastics. Accordingly, sample plots of one-tenth acre were laid out in nearby forest types, and measurements were made to determine amounts of waste in proportion to merchantable material by means of formulae for finding the cubic volume of trees. Measurements were taken down to a minimum of five inches for saw logs and to 2.5 inches for cordwood.

In coniferous stands, waste varied from 9 per cent to 72 per cent and averaged 30 per cent. Hardwoods have very little waste, about 10 per cent, when using cordwood as a basis of measurement.

Boards and slabs from logs of various sizes were weighed and recorded. Weight of the sawdust was computed from the number and size of the cuts. When sawing round-edged and square-edged boards for maximum production from each log, lumber constitutes two-thirds of the weight of the log, and slabs and sawdust make up about one-third. These proportions vary only slightly with the size of the log.

Several white pine trees of each diameter class were felled and cut into lengths that could be weighed on small scales. Practical log lengths were carefully determined and recorded as logs. The larger limbs and the top from five inches to two inches in diameter were recorded as cordwood. The remainder, including small limbs and leaves, were recorded as waste.

Curves were drawn for logs, cordwood and waste volume for trees of all diameter classes from three inches to 12 inches in diameter at breast height. Volume tables have been constructed from these curves.

Volume and weight ratios of green and dry wood were determined by moisture content and volumetric studies, and the results by green weight were changed to volumes in cubic feet, board feet, and pounds of dry weight. Stem counts were then made on several white pine stands and a table was made up to show normal full stocking. The volume table was applied to this stock table and the result is a normal yield table for second-growth white pine, showing merchantable volume in board feet, cordwood in cords, and waste in tons per acre. A similar table has been constructed for hardwoods, showing merchantable volume in cords per acre and waste volume in pounds of dry weight.

It is found that waste varies from 25 to 42 tons per acre, dry weight, in stands from 6 to 12 inches in diameter, when sawlogs are the basis of utilization, but only 19 to 32 tons per acre if cordwood is used as a basis of utilization. This waste averages approximately 35 per cent on a cordwood basis and 47 per cent on a sawlog basis.

L. C. Swain, W. A. Johnson

FRUIT PRODUCTION

Composition of Fruit Spurs as Related to Fruit Bud Formation

Since one of the collaborators has left the Experiment Station, it has not been possible to prepare a complete report for this project. It is felt,

however, that the main features of the results are of sufficient interest to warrant recording here.

In 1930, results were published (Tech. Bul. 42) of a study concerned with relation between the composition of new growth of non-bearing spurs on the Baldwin tree and the formation of blossom buds by similar spurs the following spring. A highly significant positive correlation was found between the nitrogen content of the spurs and the formation of blossom buds. This result was in such striking contrast to the generally accepted ideas on this subject that it appeared desirable to repeat the experiment. Samples for the first experiment were taken in 1925 and those for the second in 1931.

A preliminary report of the results of this second experiment was presented in 1936 at the Rochester, New York, summer meetings of the American Association for the Advancement of Science, but it was not submitted for publication.

For the spurs sampled in 1931 a highly significant positive correlation was found between starch and the formation of blossom buds. The findings for the two sets of samples were not in agreement; in fact, they were exactly contradictory.

That the two seasons were unlike is shown by the rainfall for May and June, just previous to the usual time for the differentiation of blossom buds and to the time the samples were taken. In 1925 the total rainfall for these two months was 4.83 inches and in 1931 it was 8.55 inches. Other environmental factors also may have been effective.

At any rate it appears that in 1925 the general level of carbohydrate accumulation in fruit spurs was adequate for blossom bud formation, and that such formation was limited by the extent of accumulation of nitrogen compounds. In 1931 this situation was reversed.

T. G. Phillips, G. F. Potter

The Nature, Causes, and Prevention of Winter Injury to Fruit Trees

This study was continued to determine methods of more accurately measuring winter injury as it occurs. A method was developed to measure accurately the internal tree temperature at any depth and at any instant by means of the potentiometer-thermocouple. Copper-Constantan Thermocouples, No. 30, were inserted in a peach tree as follows:

A hard steel wire 1 m.m. in diameter was sharpened and then inserted into the bark and cambium layer and pushed downward along the southwest side of the tree. Being flexible this wire easily moved through the thin-walled cells of the cambium, a distance of 2.5 inches parallel to the surface of the trunk. This distance is necessary to avoid incorrect readings due to thermal conduction. To insert thermocouples at a greater depth, holes of 2.5 m.m. in diameter were drilled downward from the lower crotch of the tree, a distance of at least 2.5 inches. A greater distance would, of course, be necessary when working with trees of larger diameter.

A small plug of cotton was forced into the holes where the lead wires emerged from the tree, and the cotton plug was then covered with grafting wax. Lead wires were run through a 1.5 inch pipe to a room 100 feet distant in which our Leed and Northrup Portable Potentiometer Indicator

was set up. This apparatus equipped with automatic reference junction compensation was operated manually. Temperatures were recorded at one-hour intervals for several successive days during January, February, and March. It should be stated that the peach tree under investigation was five years old, of moderate vigor, with sound trunk, and was located on a moderate northeast slope. Thermocouples were inserted 18 inches above the ground level.

The results are significant and merit review here. During prolonged sub-zero weather, temperatures in the cambium layer and 1.5 inches deep were nearly identical with the temperatures of outside air. Temperatures taken in January show that at midday in clear weather growing temperatures are reached in the cambium layer on the south side of peach trees even though temperatures of the air are below freezing. On the contrary, night temperatures in this cambium layer reach nearly the same degree as those of the air outside.

More complete temperature studies will be made in conjunction with electrical conductivity measurements taken during the same period. It is to be understood that this approach to the problem of winter injury to fruit trees is in a preliminary stage.

Further investigations have been made with dormant raspberry canes, which were shaded to produce more uniform diurnal and nocturnal temperatures, but with no apparent results to date. It is believed that much of the winter injury to blackberry canes is associated with spur and cane blights. A spraying program is now under way in cooperation with the station pathologist to prove or disprove this theory.

R. Eggert, A. F. Yeager, L. P. Latimer

Storage of Apples of the McIntosh Family

McIntosh apples from a single orchard were placed in common cold storage and in air-tight gas storage from October 1942 until January 15, 1943. Those in gas storage were held for this period in from 8 to 10 per cent carbon dioxide generated by their own respiration. Due to internal breakdown McIntosh apples are normally marketed from common cold storage by the last of January. At that time we placed several bushels from the gas storage room into the common cold storage room in order to determine the effect of gas during the first part of the storage period on the length of time apples of this variety could be kept in marketable condition, compared with those held for the entire period in common cold storage. Eight bushels of fruit from each of the two methods of storage were graded on July 8, 1943, on the basis of marketable fruit. Only a total of three measured boxes of the apples from common storage were marketable, compared with 6⅔ boxes of those taken from the carbon dioxide gas storage. At an earlier date other boxes from each type of storage were removed to the laboratory and left in a temperature of about 70°F. until complete breakdown occurred. These results also indicate that fruit held in 8 to 10 per cent gas during the first part of the storage period will keep at least one week longer, under these conditions, and with less shrinkage after removal from storage, than will fruit stored by the conventional method.

These results show that gas storage properly regulated is feasible for one who wishes to open that storage and remove part of his apples at any period. The remaining fruit will still keep better than that held the full period in common storage. He will be able to place on the grocers' shelf a product which will hold up longer even during adverse conditions.

R. Eggert

Spray Management

Orchard spray management varies greatly from farm to farm and from year to year on the same farm and is associated with variations in and quality of fruit. Actual average yields range from 55 to 290 per cent of the expected normal for the 40 farms studied. The lowest yield reported for any one year was 19 per cent of normal and the highest was 371 per cent. Actual productions on 32 farms over a four-year period was 312,290 boxes of commercial apples compared with an expected normal yield of 271,607 boxes. For nine farms the average yield was below the expected normal and for nine other farms the yield was 50 per cent above.

Individual orchards fluctuated from year to year. In one instance yield and quality of fruit. Actual average yields range from 55 to 290 per cent of the expected normal for the 40 farms studied. The lowest yield reported for any one year was 19 per cent of normal and the highest was four-year period. In another orchard yields were 87, 371, 69, and 133 per cent of normal. In several instances, yields were consistently low; for example, one operator reported yields of 35, 60, 41, and 48 per cent of normal.

For 28 of the 40 farms the control of diseases and pests was considered commercially satisfactory based on yield and quality of fruit. The remaining 12 farms were classed as having unsatisfactory commercial control. Seventeen orchardists applied more than six sprays per year and all but three obtained satisfactory control. On the other hand, seven orchardists applied less than five sprays and only one of this group obtained satisfactory control. All growers who applied over 40 gallons of spray per mature tree equivalents and 60 per cent of those who applied from 20 to 40 gallons obtained satisfactory control. Some producers who applied more than the usual number of sprays and used more than an average amount of material per application failed to secure control, and on the other hand, a few producers who applied only five sprays and less than 20 gallons per mature tree equivalent obtained good results as determined by yield and quality of fruit.

Further analysis of the data indicates that thoroughness and skill in applying the spray and the proper timing of the application are also important items in control. Observations by the field worker support this conclusion. The four best examples of most successful control had few if any apple trees more than 30 years of age. It is more difficult to apply a spray into the tops of the older and higher trees and many orchardists fail to recognize the need for covering adequately all portions of the tree.

H. C. Woodworth

Fertilizing Elements for Fruit Trees

Tests made during the past year have indicated that the type of leaf scorch with which certain apple orchards are troubled may be due to a nutrient deficiency. Apparently, no individual element is responsible as such, but evidence tends to show that the scorch is caused by an unbalanced condition of elements in the soil. Calcium plus either magnesium or potassium have improved growing conditions of apple seedlings in the greenhouse. In the field there is some evidence that calcium has been beneficial. Magnesium and potassium in combination, with calcium absent, have shown adverse effects. Previously, it had been shown that when potassium was applied to orchard soil, scorch became worse.

In a cooperating orchard in Wolfeboro where leaf scorch was prevalent, the soil was sampled by two-inch levels for pH values and by cores for physical constants. Samples were taken both from under trees that had previously shown severe scorch and from under scorch-free trees. The pH values were very uniform and in some cases very strongly acid, varying between 4.67 and 3.95. There was no relation between the previous occurence of scorch and volume-weight, field moisture, total pore space, non-capillary pore space or rate of percolation. Very little scorch appeared in this orchard during the past growing year.

An experiment was set up in the No. 35 orchard in order to determine the effectiveness of various mulches in preventing the appearance of scorch or mineral deficiences in apple trees. Sod, cut hay, sawdust, and seaweed were the treatments. The soil under each tree was sampled by two-inch levels to a depth of eight inches in order to determine the pH values of the soil at the start of the experiment and the amount of pH variation. Considerable variation was found in the top two levels.

Heavy application of borax to apple trees has shown that 10 pounds or more may cause serious injury to bearing apple trees, but recovery may take place if no further applications are made at the rate of 10 pounds per tree. With 20 pounds per tree recovery is less evident, and a repetition of 10 to 20 pound applications caused serious damage to trees receiving like amounts the previous year.

A rapid method for the determination of nutrients in plant tissue was devised according to that of R. C. Tindner and C. P. Harley of the Bureau of Plant Industry, U. S. D. A., Wenatchee, Washington.

L. P. Latimer, G. P. Percival

Development of Low-Bush Blueberry Fields

This project is concerned with the methods of propagating and establishing the low-bush blueberry on abandoned land.

One of the most simple and efficient methods of propagation has proven to be that of plowing narrow furrows about four feet apart in early spring and then laying the rhizomes against the land side of the furrow. The furrow slice is then firmly placed against them. Observations are noted of the rate at which these rhizomes spread. Areas covered with gray birch and pine, under which there is a weak plant growth, were cleared. Those areas are now producing a vigorous growth of new top and should to be very productive by another year.

Plots of well-established plants were staked out and some were treated with varying concentrations of fertilizers and some with lime. Those treated with nitrogen are the only plots showing any response to fertilization as indicated by the vigorous growth and dark green color. None of the plots treated with lime in any concentration have shown any response. In conjunction with the Botany department a few plots were treated with ammonium sulfamate in varying concentrations in order to determine possible weed control. The ammonium sulfamate in all doses greater than 1/16 pounds per gallon on 100 square feet proved lethal to blueberry as well as to weeds, indicating the ineffectiveness of this material as a selective spray.

The department of Entomology, cooperating, reports that there were no infestations of insects on bushes during the past year.

A. F. Yeager, R. Eggert, A. R. Hodgdon, M. C. Richards, J. G. Conklin

Improvement of the High-Bush Blueberry

Observations of high-bush blueberry plantings of standard varieties in selected areas of the state indicate a lack of soil adaptation for a successful development of the high-bush blueberry in some sections.

Varieties in the experimental plots that are making the most desirable growth are on soil of somewhat porous texture. Those on clay soils are making little or no growth, even though those soils are equal in fertility, or higher in fertility than the lighter soils. The department of Agricultural and Biological Chemistry, cooperating, is making a careful analysis of soil samples selected from under many wild bushes that are making vigorous growth. Fertilizers applied under bushes growing in clay soil have given no response. An early spring application of sulphate of ammonia on plants in sandy soils is giving excellent growth.

R. Eggert, A. F. Yeager

Fruit Cultural Studies

Mature Northern Spy apple trees with sod mulch look much better than those without mulch. They are distinctly darker in color and more vigorous. Young trees with a rye cover crop were nearly killed by excessive drying of the soil.

L. P. Latimer, A. F. Yeager

Varietal Trials

Raspberry varieties which best survived this past severe winter were Tahoma from the State of Washington and P78 from North Dakota. Sunrise, Chief, Ruddy and Latham showed some injury. Taylor and Indian Summer killed to near the ground, and Marcy was injured still more. Among the blackberry varieties Snyder and a numbered variety from the New York Geneva Experiment Station were the only ones which endured the winter without injury. Alfred is being discarded as a useful variety because of winter injury and also because of its failure to produce fruit even when not injured. Brainerd also winter kills too seriously to be of any value to this section. Most foreign plant introductions proved to lack hardiness, although Plant Industry #136141, *rubus thyrsoides*

florepleno, came through in very good condition this past winter, much better than boysenberry, nectarberry or youngberry which it resembles in type of growth. Among the cultivated blueberries Concord is most promising. Among apple varieties Melba is the most hopeful of the early varieties. Kendall appears to have some merit as a late variety among the McIntosh group and Medina of the Delicious group deserves further observation.

Low winter temperatures and length of growing season are important climatic factors governing the choice of grape varieties for adaptation to various sections of New Hampshire. The Kendaia has proven most promising because of its general vigor and resistance to low winter temperatures. The Van Buren and Fredonia varieties are reasonably hardy and will stand the winters in the southern part of the state. All three of these varieties produce an excellent quality of fruit. Such other hardy varieties as the Beta and some of the Minnesota seedlings are undoubtedly suitable to growing in the more northern sections of the state, but the quality of the fruit does not warrant competition with other varieties in southern New Hampshire.

The Pathfinder variety of strawberry continues to rank first among the new varieties of commercial strawberries now on trial. After several years of propagation the plants of this variety continue to remain vigorous, disease-free, and highly productive. The Catskill is also a heavy bearer of high quality fruit and is recommended especially for home use. The Dresden which has shown considerable promise during three seasons preceding was somewhat disappointing this year. The plants of this variety do not retain their vigor after successive propagations as well as the Pathfinder and Catskill. A satisfactory late variety has not been developed for recommendation at this time.

A number of co-operative plantings have been made in the northern part of the state, using the hardiest varieties of fruit. Some wild apple seedlings were top grafted to the hardiest of commercial varieties.

A. F. Yeager, L. P. Latimer, H. S. Clapp

Varieties of Fruits and Vegetables for Home Preservation

For two successive summers, Pathfinder, Narcissa, and Dresden have ranked high in desirability when several varieties of strawberries have been judged by a scoring panel. Texture, color, shape, and flavor were qualities considered. The Dresden, Catskill, Pathfinder, and Narcissa berries were judged to be excellent for preservation by home freezing. Frozen strawberries which were left whole and frozen with sugar or with a 65 per cent syrup were preferred to strawberries which were sliced before freezing.

The Indian Summer variety of red raspberry which ranked highest in quality for freezing in the summer 1941 again ranked highest for canning quality in 1942. Taylor and Marcy varieties of red raspberries were also desirable for canning. Color, shape, and flavor were well retained by the Marion and Sodus varieties.

Wilma Brewer, Tatiana Levcowich

INSECT CONTROL

Penetration of Contact Insecticides

The insect toximeter which was developed in the department of Entomology and described in a previous report was adapted to studies of adult insects capable of flying while a test is in progress. A spherical cage was devised and made available in quantity in order that replications might be run without delay. A cage is maintained on the turntable of the toximeter and is slowly revolved while an application of a test material is proceeding. The atomized spray is directed toward the cage from opposite points so that the two cones of spray meet in the cage and fill it with mist. After the caged insects have been subjected to a spray the cage is removed and the insects are transferred to an observation cage. The test cage is then washed in acetone to remove spray residues.

House fly adults were used for this series of experiments. A room in which temperature and humidity are controlled was equipped for rearing flies in large numbers. A second room, also equipped for control of temperature and humidity, was equipped with racks on which a large number of observation cages could be placed.

Various synthetic organic compounds, dissolved in household spray kerosene, were studied as to toxicity. Among these, three were discovered which gave promising performance. These three represented two new groups of synthetic compounds. Each of these was toxic to adult house flies in reasonable concentration. Each of the three gave initial paralysis as well as ultimate death.

In the present war emergency these studies are especially important because such compounds as these may be able to take the place of imported supplies of pyrethrum, grown in Africa and now unavailable except in limited quantities. Because of the fact that contact sprays such as the ones described are important in control of insects carrying human disease, discovery of materials which can be made in a chemical manufacturing plant has added significance.

In the course of these studies a large number of tests have been run and a large amount of data accumulated on the characteristic performance given by various chemicals when utilized as contact insecticides.

A further study of contact insecticides involved investigations in the performance of materials in the form of dusts. As a part of the necessary equipment an apparatus was built for impregnating inert materials such as talc or pyrophyllite with controlled amounts of a toxic substance in liquid form. Impregnation was accomplished by delivering the inert into a chamber at a controlled rate and by atomizing the liquid into the midst of the dispersed dust as it entered the chamber.

The usual procedure for preparing impregnated dust is first to prepare a so-called "master batch" which is made by adding a measured weight of liquid to a measured weight of inert in a ball mill, or other mixing device, the liquid present in much larger percentage than is desired in the final product as actually used. This "master batch" is then diluted by mixing with an inert. In the apparatus constructed in the entomological laboratory the liquid toxicant is atomized into a dispersed inert in the exact proportion in which it is ultimately to be studied. In the case of the

"master batch" it may be presumed that only a part of the particles in the final product carry the toxicant. In the method used in the laboratory it is presumed that substantially all of the particles carry the toxicant, but in reduced amount.

A series of experiments were run in which the performance of given toxicants was studied when present at a pre-determined percentage in an inert by the master batch method, as compared with those prepared by the direct impregnation method. The data indicate that a given amount of toxicant exhibits greater performance when added to an inert dust by the direct method than when added by the master batch method. The difference in favor of the direct method is frequently as much as two to one.

This investigation appears to be the first that has been conducted comparing the two methods of preparing contact insecticide dusts. The results of the study are probably important as pointing the way toward more efficient use of both natural and synthetic contact insecticides when applied in dust form.

W. C. O'Kane, L. C. Glover, J. W. Enke

Penetration of Ovicides

Investigations of contact insecticides are supplemented by similar investigations of ovicides wherever suitable material is available. The techniques employed are similar and the chemicals under study are frequently the same. Chemicals which indicate toxicity as contact insecticides against the mobile stage of insects are further studied as to their toxicity when applied to the egg stage, especially chemicals soluble in oils. In the light of earlier work by the department, these ovicides may be expected to penetrate the resistant surface of an insect egg.

Apparatus was constructed in the department greenhouse by means of which applications of materials could be made to insects present on plants during and after the egg stage. A toximeter was constructed which was provided with a revolving turntable and with two sources of atomized spray delivered from opposite points to a plant revolving on the turntable. In addition, racks were constructed on which potted plants could be placed after application of chemicals. The pots stand in shallow trays containing water. The plant itself is enclosed within a spherical cage which is suspended in such a way that the plant does not support the cage. Thus, insects are confined on the plant, but with free access of air. At the same time, observations can be conducted without removing the cage.

Eggs of the Mexican bean beetle were included in tests of new materials which might serve as ovicides. No materials were discovered which are toxic to these eggs without at the same time being toxic to the plants on which the eggs are laid.

Further studies are provided for in which it is expected to use potted apple seedlings infested with a species of aphid. The upper part of a seedling can be confined within the cage described above. It is hoped that by suitable control of temperature, egg stages of these aphids may be obtained for further studies of the penetration and toxicity of ovicides.

W. C. O'Kane

Insect Record

Work on this project has continued in a manner similar to that of previous years.

Field observations on the European spruce sawfly indicated a still further decrease in infestation as compared with 1941. Only in the Pittsburg area was it possible to collect cocoons in numbers, and even there no apparent defoliation took place in 1942.

Because of the importance of mosquitoes in areas in and around military establishments, an effort has been made to determine where breeding areas occur, with particular reference to disease vectors. The department is cooperating with military authorities in this work. During the summer of 1942 *Anopheles quadrimaculatus,* the principal vector of malaria in the East, was found breeding in moderate numbers at one site within the coastal defense area near Portsmouth. Prolific breeding of this species was observed in Durham, within easy flight range of military barracks. *Anopheles walkeri* was collected for the first time in New Hampshire in 1942. The relation of this species to transmission of malaria is not well known, although naturally infected specimens have been reported in the literature.

Survey work on mosquitoes is being continued.

J. G. Conklin

ORNAMENTALS

Flower Variety Trials

1. Carnation

Production records were kept on eleven standard varieties and three New Hampshire seedlings. Plants were benched from flats in early June 1942, and grown indoors during the entire period. Production for these varieties has been carefully measured and recorded and notes made with respect to selected characteristics such as quality of bloom, color, length of stem, keeping quality, splitting habits, and season of production.

Nine newer varieties were under observation during the 1942-43 season and notes made for each similar to those for the standard varieties. Thirteen new varieties plus the most promising from the 1942 season constitute the trials for 1943-44.

2. Snapdragon

Records have been kept on two-year production of the newer snapdragon varieties under different soil treatments. The treatments were designed to determine the comparative value of new compost versus old greenhouse soil and to determine the effect on quality of flowers and total production when additional manure, or cinders, or both, are incorporated in the soil. Although another year is needed for final conclusions, the following seem likely as a result of current observations:

1. The addition of small amounts of cinders improved quality and total production. The addition of one bushel of washed cinders to plots of 23 square feet increased production of No. 1 blooms by 47, or 13 per cent over comparable plots not having this additional aeration.

2. The addition of manure to old or new soil has not proven beneficial so long as nutrient levels were kept up by chemical fertilizers. In fact, manure has decreased production in two or four replications.

3. There has been no significant difference in the production from new and old soil. Soil in which carnations had been grown the previous year produced a fine crop of snapdragons with only one light feeding of nitrate applied March 1 near the end of the crop.

James Macfarlane, W. D. Holley

Ornamental Trials

In this test many foreign introductions of the Bureau of Plant Industry are being tested along with newer varieties and species of shrubs from other sources. One of the promising new plants is Korean box which while injured somewhat during the past severe winter may nevertheless be hardy enough to provide a satisfactory low broadleaf hedge for this area.

W. D. Holley, H. S. Clapp

House Plants

Rather complete cultural information has been obtained on 16 house plants since the project was introduced in August, 1940. This information has been accumulated under actual home and office conditions and answers many questions regarding house plant ills. The plants completed thus far include the following:

African Violet
Begonia (several varieties)
Boston Fern
Browallia speciosa major
Calla Lily Begonia
Chrysanthemum (for home grown pot plants)
Cordyline terminalis
Cyclamen
Dracena Godseffiana
Gardenia
Gloxinia
Heuchera sanguinea
Manettia bicolor
Primula malacoides or Baby Primrose
Pteris or Table Fern
Streptocarpus or Cape Primrose

Breeding work is being carried on with a number of plants in an attempt to develop new and more interesting house plants. Two very fine chrysanthemums have been developed for pot plants. One of these, a dwarf, ball-shaped, white variety won an Award of Merit at the Chrysanthemum Show held by the Massachusetts Horticultural Society in 1942 and has been named Granite State. The other is a large flowered bronze "mum" that has been named Chocorua. Both these varieties were distributed to commercial propagators over the country in 1943.

The begonia is being studied for inheritance of doubleness and other characters. Several fine new begonias are resulting from this work, especially a double white-flowered strain, and also attractive semi-doubles of easy culture. A paper on begonia inheritance is being prepared for future publication in the American Society of Horticultural Science proceedings.

Seven different inter-specific hybrids have been obtained from crosses made with species of Kalanchoe, a genus of succulent plants. Only one of these hybrids has been self-fertile so that a second generation could be grown. However, some of the hybrids are very promising as house plants, since they are very easily grown in the home.

James Macfarlane, W. D. Holley

Propagation of Lily-of-the-Valley

The first plantings of lily-of-the-valley were made in April 1942 when one thousand each of two German strains and one thousand of a local strain were planted in alternating rows. In September 1942, plantings were made of two additional local strains and fertilizer applications were made to four sections of the field as follows: 0 - 20 - 20 + manure, manure alone, 5 - 8 - 7 + manure, and 5 - 8 - 7 alone.

Some pips were dug and stored for forcing trials during the summer of 1943. Considerable attention must be given to grading, storage and forcing of lily-of-the-valley. Also the method of field culture now being used will prove expensive because of weed control. Another year plantings will be made under deciduous woods to obtain comparatively weed-free conditions of growth.

Results of fertilizer treatments and comparative forcing quality of the various strains will be available at the end of 1943.

W. D. Holley

PASTURES

Pasture Management Studies

There appears to be no long time difference in the effectiveness of brush control on pastures whether brush is burned, cut, or pulled. Since burning requires much less time per acre than hand cutting, or pulling, this should be the accepted method. If the land is not too rocky or too rough to prevent the use of a power brush mower, this method of brush removal should be the most efficient. On many of our good soil pastures, however, hand cutting is the most practical method due to the ponderance of rocks and boulders.

Two kinds of brush are not easily controlled: low bush blueberry and sheep laurel. The eradication of sweet fern responds readily to cutting and new plants are easily pulled.

About 60 hours per acre were required for burning, 80 hours for cutting, and 100 hours for pulling. At the end of five years, an hour per acre should be sufficient to cut or pull brush renewal. The amount of time involved for reclaiming pastures, even by the cheapest method, makes it necessary to select only those areas where the soil is such that good pasture will be obtained after brush is removed.

Results indicate that continued attention is important. Both the annual removal of new brush and sound fertilization are practical and economical in order to maintain adequate growth of good pasture vegetation.

M. F. Abell, D. Hosken

The Production of Full Roughage Requirements on Dairy Farms (with Special Reference to Pastures)

This experiment was outlined in 1942 as a continuation of, and supplement to, a pasture top-dressing experiment which for many years had engaged our attention. The new project embraces in its scope the forage needs for the whole farm, but deals in some of its phases with the use of larger grasses and legumes for permanent pasture. It involves plowing, working the land with a bush and bog harrow, reseeding at various rates and with various kinds of fertilizers in different amounts, and other phases of the pasture program.

One of the chief objectives is to determine how much more productive are the hay grasses such as timothy, orchard, smooth brome, perennial rye, Reed canary grass, and tall fescue than are the properly treated permanent pastures during the hot summer period. It is conceded that even with optimum fertilizers the permanent pastures of New Hampshire are not adequate to keep high-producing cows in flush milk production during July and August. The objective here is to determine whether one or more of these perennial grasses, carefully seeded and managed in association with Ladino clover, will meet this midsummer pasture shortage. This slump is now being supplemented in a variety of ways: by producing and carrying green feed, by pasturing annual crops such as oats or millet, by feeding summer silage, or by heavy barn feeding.

Tests are supervised on 15 farms, at least one in each of the 10 counties. It is proposed to supplement the more technical observations with those of the respective farmer cooperators. In some instances, a whole field is seeded to a single mixture, whereas in others the field is divided into large plots of about one acre to provide for variable seedings. These areas are all being pastured during the 1943 season. Many tests are caged in order to determine variations in yield due to seeding mixtures and fertilizer applications.

When feasible, some seed beds are plowed and others are prepared by the bush and bog harrow in order to contrast these two methods of preparation. Farmers report that the bush and bog harrow when operated with a tractor reduces the necessary time for seed bed preparation about one-third. Furthermore, this method had a distinct advantage on rough or rocky land.

Inasmuch as this experiment was not introduced until the summer of 1942, definite conclusions are somewhat premature. However, a few observations are perceptible from the seedings made in the spring of 1943. Tall fescue is proving to be coarse, hard, and apparently unpalatable, whereas orchard grass is reported by farmers as being very palatable, but tends to crowd out Ladino clover when used at the rate of more than four pounds per acre. Italian rye grass tends to form a dense sod and to crowd out everything except orchard grass. Perennial rye grass establishes itself quickly and crowds out Ladino clover, and is not as palatable as timothy orchard grass.

The department of Agricultural and Biological Chemistry is cooperating on this project by determining the nitrate levels in the respective soils.

F. S. Prince, P. T. Blood, M. F. Abell, T. G. Phillips, K. S. Morrow

A Study of Pasture Species under New Hampshire Conditions

This project is concerned with both the breeding and testing of various species and strains of potential pasture grasses.

I. Breeding Work

The breeding phase of this work has progressed with three species, timothy, red clover, and white clover.

A. Timothy: Enough seed was available from two strains of timothy to make small plantings in the field and for seeding in small plots in the nursery. Two types were selected for this experiment. One was a tall growing strain of late hay and the other was a shorter but vigorous pasture type which develops an abundance of basal leaves. There are 40 parent plants in the late hay type and 25 in the pasture type.

Seed has been saved from each of the parent plants in both cases and some of it has been bulked for field multiplication. This year, seed from each plant will be sown in small individual plots for observation and perhaps for recording yields.

The bulk seed sown in small plots in the autumn of 1941 was produced in the greenhouse during the latter part of the following winter. These plots were divided into four parts, one of which was clipped each week, one every two weeks, one every month, and the fourth section was allowed to mature. The pasture type showed a relatively greater power of recuperation after clipping, especially when clippings were more frequent.

Seed of both these strains are to be multiplied as rapidly as possible, because they may have specific value for at least a limited area of New England. It is planned to seek further improvement by adding desirable plant material to these strains and to eliminate undesirable plant material.

B. Red Clover: During the winter of 1941-42 about 60 reciprocal crosses were made in the greenhouse among the F_1 progeny of the twelve original families of red clover that showed some perennial characteristics. In the summer the seed was scarified, planted in plots, and later the plants were set in the field. Since there was some loss in the spaced plants due to winter killing, some of these plants were set in drills about six inches apart to see if this loss could be reduced. Other plants were set in checks about two feet apart and mulched with straw in late fall.

The third season's harvest of seed was taken from the first planting of these perennial families. In the late summer, plants were selected, potted and placed in the greenhouse for further crossing during the winter.

C. White Clover: During the past years large, hardy, wild native, white clover and Ladino plants have been chosen and crossed artificially. The F_1 generation was started in the greenhouse early in 1941 and set out in the field during July. In October cuttings were taken from 14 of the plants that were the leafiest and most vigorous. These were removed to the greenhouse and during the winter backcrosses were made with Ladino parents from a field seeded in 1937. Seeds from these crosses were planted in the greenhouse last spring and 285 seedlings representing the F_2 generation were transplanted to the nursery in the summer of 1942. Cuttings were taken from the most desirable of these last autumn and removed to the greenhouse. These will be backcrossed with Ladino.

The purpose here is to develop a more leafy strain of white clover than that of Ladino, and one which may better stand close grazing. At the same time it is desirable to retain the height characteristics of Ladino and to have a form of clover that will compete with the tall grasses of seeding mixtures.

In addition to the breeding work that has been conducted in the greenhouse with white clover, 16 of the F_1 plants were caged during the summer of 1942 and bees were introduced for open pollination. Seeds produced from the plants so crossed have been saved and kept separate. These will be planted in small plots, by families, in 1943, for observation as to growth characters and other desirable or undesirable characteristics.

II. Testing of Species and Strains

A large number of strains of grasses from a variety of sources are being tested in the nursery. These include more than 100 duplicated rod row plantings of timothy, orchard grass, perennial rye grass, fescues, Kentucky bluegrass, smooth brome grass, and others. Among these are many promising sorts. Particular attention was given to timothy, especially for hay purposes. Of the timothies under test any one of the following was superior in size, leafiness and yield, to the "commercial" crop which was seeded for comparison: Milton, Montcalm, S51, S48, Cb 213, Cb 224, O.A.C. No. 1 intermediate, O.A.C. No. 1 hay type, Hall's Stream (local), Mountainview (local), Cornell 4059, F.C. 19578, F.C. 15167, F.C. 28116, F.C. 28114, F.C. 28113, and F.C. 28111.

Of orchard grass strains, the Welsh selections S26, S37 and S143 are leafier, and later in heading than the others under trial. Avon, O.A.C. No. 1 and CC180 are also desirable strains.

The so-called creeping brome grass types (smooth brome) do not creep much more in our climate than the non-creeping types. The bromes have not been seeded as long as the timothies and orchard grass strains, and it is probably unfair to draw conclusions in respect to them at this time. This is also true of the other grasses.

F. S. Prince, L. J. Higgins, P. T. Blood

Eradication of Common Buttercup, *Ranunculus acris,* from Permanent Pastures

Plots have been laid out in three pastures in different parts of the state: (1) At the Foss farm in Durham, (2) at the R. S. Lyons farm in West Claremont, and (3) at the Roe MacDonald farm in North Haverhill. Areas selected for these plots were those of dense infestation and in which a considerable degree of uniformity in weed content was evidenced. Square plots 10 feet on a side were selected as being of proper size for treatment. Only substances of a non-toxic nature, or at least those which leave no toxic residue, have been used thus far. In each pasture three herbicides; borax, ammonium sulfamate, and Sinox have been applied. Some plots have been cut periodically and others have been treated with fertilizers in heavy concentrations.

Borax was applied in concentrations varying from 4 pounds to ½ pound per 100 square feet. Ammonium sulfamate was applied in dosages varying from 1 pound to 1/32 pound per gallon of water on 100 square

feet, and Sinox plus ammonium sulfate as an activator in concentrations of 1½ ounces of each in a gallon of water. Another treatment with one ounce of each in a gallon of water was applied. Controls are present in all cases.

Inasmuch as the first treatments were started in early May of the present year, it is too early to draw any definite conclusions. However, it is apparent that, in those plots treated at the start of the buttercup flowering (about June 1), concentrations of ⅜ to ¼ pound of ammonium sulfamate per gallon of water distributed evenly over 100 square feet of infested pasture made a thorough kill of the buttercup. Presumably, however, these concentrations cause considerable destruction to the prevailing pasture grasses and clover, particularly the latter. Further experimentation is necessary to indicate the most effective amount of material to use and the most desirable time to apply it.

A. R. Hodgon, F. S. Prince

PLANT BREEDING

Strawberry Improvement

From more than 4000 crosses made in the greenhouse a year ago, approximately 200 strawberry selections have been made. The plants selected bore fruits possessing one or more of the following characteristics: firmness, solid red color, good flavor, good size, and late maturity. Pathfinder has apparently been an excellent parent, as selections of this parentage predominate. Of the individual crosses Catskill crossed with Pathfinder gave the greatest number of promising seedlings. As an individual parent Catskill gave the greatest number of seedlings. Pathfinder and others also rank high in this respect. Green Mountain was the least promising parent. Claribel was promising only in that some seedlings of this variety produced late maturing fruit. Tupper gave seedlings that were very vigorous and late maturing fruit.

L. P. Latimer

Tomato Breeding

Three new introductions have been developed and are being grown to a considerable extent in this state. These include Orange King, a tangerine flesh, determinate variety, medium in earliness; New Hampshire Victor, a variety of similar parentage to the regular Victor, but one which seems to be somewhat more resistant to leaf diseases; and Early Chatham, an extremely early, red, determinate variety, particularly useful where most varieties do not mature. Attention is being given to new crosses between ordinary varieties and *Lycopersicon Hirsutum*, which shows some resistance to late blight. New crosses have also been made between Orange King, a high vitamin variety, and another extremely high vitamin C content tomato. Some crosses between ordinary varieties and Plant Industry #126923 are giving progeny which is extremely early and indeterminate. Whether it will be possible to get a tomato of commercial size on indeterminate vines which will be extremely early remains to be seen.

A. F. Yeager, R. Barratt

Muskmelon Breeding

Considerable progress was made during the year in purifying early muskmelons of high quality which have perfect flowers. None were ready to introduce for the current season.

A. F. Yeager

Induced Polyploidy

Tetraploid plants that were made from crosses between Buttercup *Cucurbita maxima* and African Bell *Cucurbita Moschata* produced no viable seeds, although the diploid plants of the same cross gave good seed. On the other hand, a cross between Buttercup and Butternut, also *Cucurbita Moschata*, which was carried through the first generation in the greenhouse produced no good seeds from diploid plants. Whether a tetraploid of the same cross would have been fertile was not determined.

A. F. Yeager, L. P. Latimer

Use of Apple Root Stocks

A reasonably large orchard has been established using the various malling stocks of commercial varieties. Virginia crab and Florence crab have also been used as body stocks and top worked to ordinary varieties. With the McIntosh variety Florence appears to be superior, forming extraordinarily good unions and making splendid growth. Malling #4 used as an inter-stock appears to be of doubtful value because of lack of winter hardiness.

W. W. Smith

Rubus Improvement

About 800 seedlings resulting from crosses between varieties of raspberry, blackberry and several other rubus species have been planted. Successful crosses were made between both blackberry and raspberry, and the wild species *Rubus odaratus*, or flowering raspberry.

A. F. Yeager, L. P. Latimer

Watermelon Breeding

A new variety was introduced for trial this year under the name White Mountain. This is a very small fruited variety, about three pounds in weight, which is characterized by extreme earliness, thin rind and high quality. Melons have been ripened in 65 days from seed planted in the field.

A. F. Yeager

Bean Breeding

From some crosses made several years ago under the direction of J. R. Hepler, two varieties of horticultural beans have been developed and distributed for trial. These are characterized by unusually high seed color and high pod color. They have been named Brilliant and Flash. A small-podded, white seeded, green bean which may be suitable for whole canning was distributed for trial this year for the first time.

A. F. Yeager

PLANT PATHOLOGY

Bacterial Ring Rot of Potatoes

Ring-rot-free tubers planted in soil infected with the ring rot pathogen, *Corynebacterium sepedonicum*, failed to show symptoms of infection. The soil was infested by mixing macerated diseased tubers with the soil. The tests were conducted both in the field and in the greenhouse. Tubers from the original plantings were saved and planted in the greenhouse to see whether the tubers were infected, although the vines did not show disease symptoms.

As results from the two plantings were negative, that is, no infection occurring from the soil inoculations, it is believed that under natural conditions in the field inoculation does not occur when clean seed is planted in a field contaminated the previous year by ring rot plants. It is possible that volunteer plants may be a factor in overwintering of the pathogen but in the tests conducted such plants did not survive the winter at Durham.

M. C. Richards

Spraying for Apple Scab

McIntosh apple trees were given the following spray or dust treatments: Pink, - Flotation paste, May 4; Bloom, - dust from north side, May 16; Late calyx, -dust on both sides, June 3: first cover, - Lime sulfur, June 18. In the second and third cover sprays, the following treatments were given: *Row 1*, Mike and Bordeaux; *Row 2*, Bordeaux and Bordeaux; *Row 3*, Mike, Mike, and Mike; *Row 4*, Lime sulfur plus arsenate of lead and Mike; *Row 5*, Lime sulfur and Mike; *Row 6*, Mike and Mike; *Row 7*, Bordeaux and Mike; *Row 8*, Mike and Lime sulphur. The concentrations of the materials were as follows: Mike 6⅔-100, Bordeaux mixture, 8-40-100, Lime sulphur, 2-100. Data taken at picking time showed little difference in scabby fruit for the various treatments, also little difference in fruit russeting. There was a slight increase in pin point scab on the fruit from Rows 4, 5, and 8 both at harvest time, September 21, 1942, and after storage, February 11, 1943. In these three rows lime sulfur had been used in the treatments. The spraying and dusting was carried out by the department of Horticulture.

M. C. Richards

Developing Disease Resistance in Early Tomatoes

A survey of the prevalent diseases of tomatoes in New Hampshire in 1941 showed that Alternaria blight (early blight) is by far the most important. The fungous pathogen *Alternaria solani*, which causes Alternaria blight, blights the leaves, resulting in lower food producing capacity of the plant, in sunscald of the fruits, and in a poorer quality crop.

An investigation was begun of the disease and its causal organism in order to prevent losses. Previous findings (1942) have shown that no selection of tomato, either wild or cultivated, is immune to the disease. However, there is a wide range in the field in the time and amount of defoliation of various varieties of tomatoes. This difference is being investigated and is related to the physiological maturity of the plant. Among

the factors believed to alter physiological maturity, the following were considered: earliness of fruit load, fruit to leaf quotient, soil moisture, and mineral nutrition. The data on the latter two proved inconclusive.

Ten plants each of 40 tomato varieties were planted in the field, and yield and per cent defoliation from Alternaria blight were recorded on each plant during the season. The onset of defoliation from Alternaria blight has been found to be directly related to the onset of fruit in most varieties. This has been demonstrated graphically.

Work on the relationship between the fruit to leaf quotient and defoliation is progressing.

An investigation has been started on the testing of all available tomato selections for resistance to late blight. To date, over 65 selections have been tested. Several of these show resistance and may serve as breeding stock.

A knowledge of the factors affecting severity of Alternaria blight will aid in the production of a tomato variety less susceptible to the disease. If a tomato variety immune or resistant to late blight is produced, much loss in certain seasons will also be prevented.

R. W. Barratt, M. C. Richards

Breeding for Disease Resistance in the Muskmelon

By controlling powdery mildew in the greenhouse, the muskmelon breeding program carried out by the department of Horticulture is accelerated by use of the greenhouse during the winter months.

Investigations in the greenhouse during the past year continued on methods of controlling powdery mildew on muskmelon. Sulfur fungicides were found impractical because of injury to the muskmelon foliage. Of the copper fungicides used, copper-oxychloride sulfate at the rate of two pounds per one hundred gallons of water applied weekly was the most effective. This spray should be adapted to field use.

Muskmelon leaves are difficult to wet evenly. Various spreaders were used in combination with copper-oxychloride sulfate in order to secure an even deposit of fungicide. An even deposit is correlated with good control and absence of fungicide injury. Of the various spreaders used, emulsified cottonseed oil or emulsified peanut oil at a concentration of one part in eight hundred was found to be very satisfactory.

Field diseases of muskmelons in New Hampshire are being investigated further but to date none have been found sufficiently important to warrant control measures.

R. W. Barratt, M. C. Richards

POULTRY

Protein Requirements of Chickens at Various Stages of Growth and Development

Previous studies of various protein levels using meat scrap, dried skim milk and fish meal have been reported. Chicks receiving fish meal or the protein mixture were significantly heavier in weight at 12 weeks of

age than were the chicks fed meat scrap or dried skim milk. Growth increased as the protein content of the ration increased from 15 to 19 per cent although chicks receiving the lower protein rations were generally most efficient in feed utilization during the growing period.

During the past year studies have been made of the vegetable protein concentrates soybean oil meal and corn gluten meal. Both supplements were fed to chicks from day old to ten weeks of age at levels of 15 and 19 per cent of protein in the ration. At both levels, those fed soybean oil meal were superior to those fed corn gluten meal. The growth differences between the 15 and 19 per cent levels of protein feeding were also significant for both protein concentrates, being in favor of the higher protein level. The growth obtained to 10 weeks of age with soybean oil meal at levels of 15 and 19 per cent of protein in the ration was equal to the growth obtained in the previously reported experiments with dried skim milk at 15 and 19 per cent of protein feeding. When compared with the earlier results obtained with fish meal, soybean oil meal feeding gave a growth response only .16 pound less at the 15 per cent level and .36 pound less at the 19 per cent level of protein.

The feed efficiency, as represented by the pounds of feed required to produce one pound of gain, was of the same order for both levels of feeding soybean oil meal The soybean rations were also more efficient than the corn gluten rations.

The mortality was low for all groups except for the lower level of corn gluten meal. Cannibalism developed in this group at four weeks of age and it was difficult to control it during the remainder of the experiment.

During the war emergency with the resulting scarcity of animal protein feeds, it appears that soybean oil meal can be used to replace part if not all of the animal protein concentrates in rations for chicks to 10 weeks of age.

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The department of Agricultural and Biological Chemistry, cooperating, using birds from the above described groups, duplicated previously reported feeding experiments in every detail, except that vegetable proteins were substituted for animal proteins in the ration: i. e., corn gluten meal and soybean oil meal fed at the 15 per cent and 19 per cent levels, respectively. Daily records of feed and water consumption, feces elimination and gains in weight were kept during the six-day control feeding periods. At the end of the feeding periods the birds were killed, the pH

of the entire alimentary tract determined. The gizzard contents were preserved for further analysis.

The fecal samples collected have been air-dried, ground, and analyzed for total nitrogen. There is no marked difference between the total nitrogen content of these feces and those of the previous experiment in which birds received animal protein in their diet. However, there were differences in growth, as reported by cooperators of the poultry department.

Uric acid nitrogen content of the feces samples obtained from the animal protein experiment previously reported have been determined. No definite conclusions on the differences between groups can be made. The variance between birds within a group is as much as between average values of groups. Further nitrogen studies on these feces will be conducted in order to determine reasons for variations between birds within a group. Similar analyses will be made on the feces samples collected in the vegetable protein experiment described above.

In order to get a more uniform basis for the uric acid comparison, the data found were reorganized by calculating the per cent uric acid nitrogen on the basis of the nitrogen consumed. The results show an apparent reversal of action between the 15 per cent and the 19 per cent levels of the two protein sources; i.e., fish meal and dried skim milk. Work on the enzyme action of the dried gizzard is continuing.

No new feeding trial is contemplated for this year. Analytical work on the fecal samples collected will be continued, and the data of three feeding experiments will be correlated.

R. C. Ringrose, T. B. Charles, S. R. Shimer, H. A. Davis

The Cause and Prevention of Gizzard Lesions in Chickens

Current progress on this study is focused on the possible role of inheritance and comparative work with various dietary control measures.

Chicks hatched from the third generation of groups giving high and low incidence of lesions followed the same trend as the previous generation. The high group was consistently high with an average gizzard score of 1.57 for 173 chicks. Greatest change occurred in the low group where the score for 168 chicks declined to 0.78 from a previous average of 0.91 for the second generation. The fourth generation of pedigree chicks is now being raised.

The effect of diet upon the cause and prevention of the condition has been studied by using a standard diet to which various supplements are added. All chicks were killed at four weeks of age and the gizzard scored for the occurrence of lesions. There is evidence that cod liver oil increases the occurrence of the condition. The reported preventive action of cholic acid has been tested and confirmed.

The previous annual report suggested the use of the Beckmann spectrophotometer to determine the enzyme activity of the gizzard, according to a method previously mentioned. Work during the past year has shown that the Klett-Summerson photoelectric colorimeter may be used to good advantage with this method. There are definite indications that it will be possible to develop this method to a practical point of operation, so that comparisons between enzymatic activity of gizzards can be

made. Work has shown that the time and temperature of the reaction must be very accurately controlled.

R. C. Ringrose, E. F. Waller, T. B. Charles,
F. E. Allen, S. R. Shimer, H. A. Davis

The Etiology, Pathology and Prevention of Contagious Indigestion

In May 1942, parts of two small flocks were inoculated with the experimental vaccine made with the "Blue Comb" virus. This was reported last year but the results were not obtained until September. In the first flock 250 out of 525 pullets were inoculated and raised together on the same range. A second group of birds, six weeks younger, were put on a separate range. In September all birds were housed and the two groups were mixed in the various pens. "Blue Comb" made its appearance in the younger pullets only. In view of some experiences here at the laboratory, it is obvious that there was sufficient spread from the inoculated to the uninoculated in the first group to establish immunity in the majority of all of the older birds.

The second flock contained only 90 pullets of which 45 were inoculated. They were divided into groups and raised on separate ranges with new equipment and new shelters. After these birds came into production a pen of sixteen hens and one male was made up from each group. These two pens were fed fresh tissues from field cases of "Blue Comb." The uninoculated group became depressed, developed a diarrhea, decreased their feed consumption and their egg production on the third, fourth, and fifth day after feeding and then rapidly returned to normal. The inoculated pen showed no visible effects although they were fed the same amounts of the same tissues and at the same time. This work is being duplicated this spring on a larger scale. Approximately 3,000 birds will be inoculated with twice that number as controls on the same farm.

At first there was difficulty in obtaining sufficient embryonic membranes to make the required amount of vaccine. An attempt was made to use the whole embryo. This, dried under vacuum, gave weak and inconsistent reactions. A combination of ground embryos and embryonic membranes were treated with various preservatives such as are used in some other vaccines: namely, formalin, phenol, ether and chloroform. The birds were injected with these preparations and daily blood examinations made for six days. Four weeks later they were reinjected with known virulent material. The one containing chloroform was the only one to give any protection and there is some doubt if the bird was immunized or if had been contaminated from an adjoining pen. Later a new technique for harvesting infected embryonic membranes was developed and the work with the chemically treated product was dropped.

Four strains of the virus are being carried in eggs at this time. Transfers are made at 72-hour intervals. All strains have become more or less constant in their reaction.

A limited amount of work has been done with turkey and duck eggs. Both are very susceptible if inoculated at twelve days instead of nine and left for 96 instead of 72 hours. The reaction is much more severe and the embryo mortality is greater. Ten duck eggs were inoculated as 12-day

embryos. These were placed in the incubator and at the end of a 12-day period only one remained alive. Additional work with turkey eggs is planned. Two young turkey hens (7 months old) were injected with known virulent virus and daily blood examinations carried out for the next five days. No reactions took place.

In an attempt to increase the virulence of the virus we have tried a number of things that have been used with success on other viruses. First we fed an excess of thiamine hydrochloride (vitamin B) to two young birds for one week before administering the virus. It did not affect the virus reaction but it did produce a clinical and a hematological picture not previously described for this vitamin.

Cystine was also mixed with the virus just prior to administration. No results were obtained on preliminary trials but this will bear rechecking.

E. F. Waller, R. C. Ringrose, A. C. Corbett

Studies in Viability in Poultry

The Avian Leucosis complex (A. L. C.) causes a greater mortality in mature fowls than any one other disease entity. Accordingly, the objective of this project is to compare the incidence of the A. L. C. in pedigreed single comb white leghorns with flocks made up of sibs and half sibs at three other experiment stations: namely, North Dakota, Oklahoma, and at the Regional Poultry Laboratory at East Lansing, Michigan. Eggs were furnished by the Michigan laboratory and the chicks were hatched and reared at the respective stations.

At the New Hampshire station 122 pullets and 10 cockerels were housed at approximately 110 days of age. During the next 14½ months 48 birds died and at the end of that period all 84 remaining birds were destroyed. Of the original 132 birds housed, 26 showed gross lesions of the A. L. C., 60 showed microscopic lesions of the A. L. C. Two were suspicious of microscopic lesions and 70 were negative. This disease (A. L. C.) continued to develop as long as the birds were kept. The large number showing only microscopic lesions indicates that this trend would have continued for some time.

In the past poultrymen felt that if they kept only yearling hens for their breeders that the disease could be eliminated. This investigation has definitely proved that the disease will continue to develop at a more or less constant rate in birds over a year of age.

E. F. Waller, C. W. Hess

SOILS

Methods for Controlling Erosion of New Hampshire Potato Fields

The objective of this project is to determine practical means of controlling the erosion of soils which predominate on the rounded hill tops of southern New Hampshire where numerous potato fields are located. The Paxton fine sandy loam is a typical soil representing these areas. Experimental work involves the management of run-off plots on the Piper

farm at Northwood and tests of various rotations on the Tasker farm at Center Strafford. In the latter case the soil had been depleted by constant tillage to the extent that it maintained no earthworm population, indicating no beneficial effects from micro-organisms in this soil. The Piper farm, on the contrary, represents a soil high in organic matter and of excellent soil structure. In this case, the purpose is to determine changes in organic matter and soil structure during the process of depleting the soil by continuous culture, and by using rye as a winter cover, compared with other crops in rotation. On the Tasker field the aim is to note changes as they occur during the process of actually building up soil structure and organic matter by introducing a system of crop rotation.

Due to changes in personnel and to labor shortage, the determination of organic matter and changes in soil structure by analytical laboratory methods have necessarily been suspended temporarily. The field work, however, is being continued and consists mainly of keeping temperature and rainfall records, measuring run-off and soil losses, harvesting potatoes, seeding rye and other crops in the experimental plots, and the like.

P. T. Blood, F. S. Prince

The Influence of Soil Texture, Soil Moisture, And Soil Aeration upon the Growth of Plants

During the winter of 1942-43, work was continued with potatoes in soil cultures. The same three soil types as used previously were Buxton clay, Newmarket fine sandy loam, and Merrimack loamy fine sand. Potatoes were grown in each type in galvanized pails at a constant soil moisture content. Each soil was sifted into three size fractions, as follows: fine, below 0.25 mm.; medium, 0.25 to 1.0 mm.; and coarse, all particles above 1.0 mm. Five plants were grown in each of these fractions and five plants in natural, or unsifted soil of each type. Each soil fraction and type was tamped to attain a 55 per cent total pore space as nearly as possible. This was about the only mutually similar amount of pore space attainable throughout the three soils types. All were grown at a moisture content of 75 per cent on the calculated basis as in the previous year. Plants were grown to full maturity instead of being harvested at 90 days as previously. A summary of the results follow:

Yields of Potato Tubers in Grams Grown in Different Soil Textures

Soil type	Natural	Texture size Coarse	Medium	Fine
Merrimack loamy fine sand	1691	1586	2333	3910
Newmarket fine sandy loam	3944	3830	3890	4038
Buxton clay	3463	3607	3319	2527

Since moisture content was optimum and constant and since total pore space was constant, it appears that texture alone, aside from air in the soil, affects plant growth and yield considerably. The yields tend to decrease with greater particle size in the Merrimack or coarse textured soil and to decline to some extent in the other extremes, or the finer clay fractions. Apparently, particle size may vary within quite wide limits in a

medium-textured soil, such as the Newmarket type, without materially affecting yield and growth.

Sand and water cultures were continued, using cabbage, corn, sweet clover and tomato, the last two to a limited extent. Cabbage gave greatest dry weight of tops with solution only, next best with fine sand and least in coarse sand, whether with or without aeration. The differences were more marked in those without aeration, however. This relationship, especially between the coarse and fine sand cultures, holds in general for the other crops in cultures without aeration, but is reversed in those with aeration, especially corn. A species difference may exist here.

STUART DUNN

A Survey of the Soils of New Hampshire

A soil survey has been completed for six of the ten counties, and the seventh, Rockingham County, is about two- thirds completed. This work is temporarily deferred due to lack of available personnel.

F. S. PRINCE, G. P. PERCIVAL

VEGETABLE PRODUCTION

Factors Affecting the Storage of Squash

Two acres of squash were grown and selections made for storage tests which involved 25 specimens divided among five different locations, each containing five squash.

The department of Agricultural and Biological Chemistry, cooperating, has taken samples, mostly of the Blue Hubbard variety, for chemical determinations. These samples were taken at various stages of maturity and at varying periods of storage. Samples were preserved in alcohol for later analysis.

Blue Hubbard squash piled in the field and covered with vines for a period of two weeks were definitely inferior in storage quality to those taken directly from the field to a dry storage or to a greenhouse and cured for two weeks. Bruising hastens spoilage materially, but bruised squashes taken directly from the field kept much better than those carefully handled after they were field piled.

Humidity is an important factor in storage. Warm storage, if dry, is better than humid cold storage, and dry cold storage is better than humid cold storage.

A. F. YEAGER, M. C. RICHARDS, J. G. CONKLIN, T. G. PHILLIPS, WILMA BREWER

Variety Trials

An experimental vegetable variety plot is being maintained at Colebrook in northern New Hampshire, an area of short growing season. Many new varieties which had previously shown some adaptation to this area were widely distributed among home gardeners for further trial.

The butternut squash, a variety belonging to the Moschata group, proved to be a very good yielder and of high quality, but failed to keep as well as other varieties in storage. It appears useful for early winter use.

A. F. Yeager, H. S. Clapp

Treatment of Seeds with Hormones and Hormone-like Preparations

Various advertisements and articles make claims for the advantages of hormone seed treatments and use on transplants. It seemed desirable to test some of these to gain first-hand information as to their growth in order to answer inquiries of interested people.

All of the commercial preparations for seeds were in dust form, being made up of hormones and, in some instances, vitamin B, mixed with talc powder. Some of the preparations for transplants were in tablet form, to be dissolved in water before treating the roots.

Fig. 4. Tomato seedings treated with starter solution, in comparison with "transplantone" at weekly intervals

Commercial preparations tested were "Seed-Aid," "Rootone," Thompson's "Pree-plant," Thompson's "Ree-root," "Transplantone." The last two were chiefly for treating transplanted seedlings. Along with these there were tested untreated seeds and seedlings for control, and seeds treated with dilute solutions of pure compounds such as naphthalene acetamide and levulinic acid.

The seeds tested were: kidney beans, lettuce, Swiss chard, radish, nasturtium, and potato seed tubers. Tomato seedlings were treated with one preparation in comparison to controls treated with an ordinary starter solution made by dissolving commercial fertilizer in water.

Results showed no advantage for any treatment. In one or two instances early growth was stimulated, especially with low concentrations of naphthalene acetamide, but the other plants subsequently caught up to them. The plants treated with starter solution outgrew those treated with "Transplantone," as shown in the photograph.

Stuart Dunn

Varieties of Fruits and Vegetables for Home Preservation

For two successive summers, Pathfinder, Narcissa, and Dresden have ranked high in desirability when several varieties of strawberries have been judged by a scoring panel. Texture, color, shape, and flavor were qualities considered. The Dresden, Catskill, Pathfinder, and Narcissa berries were judged to be excellent for preservation by home freezing. Frozen strawberries which were left whole and frozen with sugar or with

a 65 per cent syrup were preferred to strawberries which were sliced before freezing.

The Indian Summer variety of red raspberry which ranked highest in quality for freezing in summer of 1941 again ranked highest for canning quality in 1942. Taylor and Marcy varieties of red raspberries were also desirable for canning. Color, shape and flavor were well retained in canning by the Marion and Sodus varieties.

Wilma Brewer, Tatiana Levcowich

NUTRITION — VITAMINS — METABOLISM

Pelleting Horse Feeds

In response to a request of Colonel Paul E. Howe of the Army Sanitary Corps, for cooperative assistance in determining field emergency rations for army horses and mules, the time and funds alloted for experimenting with energy expenditure of horses has been applied to study this nutritional problem because of its immediate urgency. The delayed study as provided for by the project will be continued during the coming fiscal year.

The objective of these experimental tests is to pellet various combinations of feeds under high pressure in order to reduce bulk, and thereby facilitate problems of transportation, but at the same time to produce pellets which contain a satisfactory combination of vitamins, protein, and energy.

As a result of this experiment it is found that very satisfactory pellets can be made with a combination consisting of oat groats, cornmeal, beet pulp and alfalfa meal in the proportions of 1-1-1-2, respectively. The bulk is reduced to one-half that of the same ingredients when not pelleted. No binder was used.

E. G. Ritzman, N. F. Colovos, A. D. Littlehale

Nutrition Studies with Calves

The study of protein and energy utilization by Holstein heifer calves from birth to four months of age was completed during the year.

Three calves were liberally fed in order to produce the maximum inherent growth potential in each individual. During the first month, on identical amounts of milk with a digestible protein content corresponding to the Morrison standards, the respective daily gains in weight were 1.69, 1.27, and 1.37 pounds. During the second month, when, with the addition of grain and hay, the digestible protein amounted to the maximum provision of the same standards, the daily gains in weight were 2.12, 1.77, and 1.12 pounds, respectively. During the third and fourth months, with still more grain and hay in proportion to milk and with a digestible protein intake in excess of the standard maximum, the respective gains were 2.34, 1.95, and 1.78 pounds for the third month, and 2.25, 1.87, and 1.73 pounds for the fourth month. In each instance the total amount of total digestible nutrients was in excess of the standard provisions. As

compared with a 1000-pound adult animal the average daily increases by months were respectively 12.7, 10.4, 9.3, and 7.0 pounds.

About 90 per cent of this increase in body weight could be accounted for by the deposition of protein as body flesh which indicates that the growth trend is extraordinary at the start, but declines rapidly during the first four months. Even with a liberal supply of food energy, the extraordinary activity of the body tissues (metabolism) in early life burns up so much energy that relatively little fat is deposited at this time.

The utilization of digestible protein intake decreased from an average of 89 per cent (on milk only) during the first month to 77 per cent during the second, 70 per cent during the third, and 61 per cent during the fourth month. In other words, the biological value of the digested protein decreased as grain and hay gradually supplied a greater proportion of it. This does not indicate any particularly favorable associative effects, but rather a comparatively low order of biological values for cereal proteins.

That biological value of protein for growth is determined not only by the character of the nitrogenous constituents consumed, but also to a material degree by the physiological adaptability of the individual to utilize these constituents, is apparent during the first month when utilization of milk protein (for growth) by individual calves was respectively 96, 80, and 87 per cent. Similar individual differences were obtained in the percentages of metabolizable energy that were applied to net use.

The complete report of this investigation is now prepared for publication as a station bulletin.

E. G. Ritzman, N. F. Colovos, A. D. Littlehale

Nutrition Studies with Lactating Cows

The work during the current year includes ten experiments in which the complete ingo and outgo of matter and energy of lactating cows was measured by means of digestion balances and metabolism experiments. Simplified rations, containing for the most part cornmeal, ground oats, wheat bran, and linseed oil meal in proportions of 1-2-2-1 by weight, have been used.

These experiments are still in progress (now in their second lactation) and no final conclusions are advisable until this second lactation is completed when the whole picture can be presented. However, some general observations may be reported at this time.

The simplified feed mixture was entirely satisfactory. The grain mixture averaged between 12 and 13 per cent digestible protein which is much lower than is commonly used. A production of 40 pounds of milk was maintained on 8 pounds of this low protein mixture with pasture up to the middle of August when pasture conditions declined, partly due to drouth. In this case the ratio of grain to milk was 1-5.

No attempt was made to encourage maximum potential production during the earlier stage, the grain when fed in dry rations with beet pulp and mixed grass hay being kept at the ratio of one pound to about 4.6 pounds of milk. The grain was, however, gradually later increased to a ratio of one pound to about 3.0 pounds of milk to maintain the yield. On this treatment one heifer produced 11182 pounds of milk testing 4.3 per

cent fat in 348 days. Another produced 10380 in 272 days, and the third produced 7396 in 248 days.

The practical significance of present results lies in the possibilities of savings by reduced purchases of high protein concentrates without material decline in production.

As nutrition studies with lactating cows will involve at least two complete lactations for each animal, publication of the results will be deferred until tests with the second lactation period are completed. However, a manuscript on the growth phase, which was completed last year, has been prepared for publication as a bulletin from this station.

E. G. Ritzman, N. F. Colovos, A. D. Littlehale

The Effect of Vitamin A on the Utilization Of Energy and Protein by Calves

This study concerns the effect of vitamin A on the utilization of energy and protein in the ration of young calves from birth to six months of age. Three heifer calves were used, each of which was placed on a vitamin A controlled intake practically from birth to six months of age. One calf was receiving what is accepted as the normal requirement of vitamin A in the form of cod liver oil, another five times the normal, and the third one-twentieth of the normal, or practically a vitamin A deficient ration.

Three complete balances of energy and protein were obtained with the calf fed the optimum amount of cod liver oil and three with the calf receiving the deficient ration. Seventeen respiration experiments were carried out periodically to determine the basal metabolism. Blood samples were taken every two weeks from all three calves and analyzed for sugar, calcium, and phosphorus.

Calves receiving the optimum amounts of cod liver oil showed a higher percentage utilization of food than did the calf on the deficient ration. The basal metabolism of the calf on the deficient ration was nearly 15 per cent higher than that of the other calves. Furthermore, this calf went totally blind during the fifth month and high dosages of cod liver oil failed to restore sight. The blood analysis shows a low content of calcium between the time milk feeding was stopped and the time the deficient ration was fed. Utilization of energy from the ration was affected long before any deficiency symptoms appeared. The basal metabolism increased progressively as the deficient ration was fed.

While this experiment is of a preliminary nature and with too few calves, the findings warrant continuance with a larger number and with a slight revision in the procedure.

N. F. Colovos, E. G. Ritzman, H. A. Keener

Nutritive Values of Fruits and Vegetables

This project is concerned with a determination of the factors affecting the nutritive values of New Hampshire grown fruits and vegetables and is a phase of the national cooperative project entitled "Conservation of Nutritive Value of Foods." This station's contribution to this national

project has been a determination of the effects of canning and quick-freezing on the ascorbic acid and carotene content of blueberries. Such determinations were made by the Kirk and Tressler method using the Fisher electrometric titri-meter for ascorbic acid and the Moore and Ely method using the Klett-Summerson photoelectric colorimeter for the carotene of blueberries a few hours after picking, and after samples had been preserved both by canning and freezing and with and without sugar. Samples of the preserved berries were analyzed at the end of 24 hours, one-half month, three months, six months, and nine months. By this procedure the ascorbic acid and carotene content of low-bush blueberries and of seven varieties of high-bush blueberries were determined. Ascorbic acid content ranged from 10.53 to 13.36 mgs. per 100 grams of fresh material, and carotene ranged from 0.036 to 0.139 mgs.

The addition of sugar to the berries in the freezing process helped to retain the ascorbic acid during the freezing process. Blueberries frozen without sugar lost from 10 to 14 per cent of the original amount of ascorbic acid, but the loss was not increased by storage of the berries. Storage of the canned blueberries likewise resulted in loss of ascorbic acid. The ascorbic content of the canned blueberries at the end of nine months of storage was 33 to 44 per cent lower than the ascorbic acid of the fresh blueberries.

Wilma D. Brewer, Tatiana Levcowich, S. R. Shimer, H. A. Davis

Food Consumption of New Hampshire Families in Early Spring

Information about the adequacy of diets of New Hampshire people is necessary for a planned nutrition education and research program. Questionnaires were prepared which contained a record of food servings over a week's period. These were submitted to New Hampshire homemakers and 570 forms were returned. Analysis of the data has been completed.

The results indicate that in March, 1942, New Hampshire families on the whole included adequate amounts of meat, eggs, green, yellow and other vegetables in their diets. Fruits, particularly citrus fruits, were lacking in the diets of families with incomes of $2000 or less. Village and city families did not use adequate amounts of milk, whereas most farm families included milk in their meals in amounts sufficient to meet the requirement of one quart per child or one pint per adult per day. The number of weekly servings of the various feeds were compared with the standards of the nutrition yardstick.

Records of home production and preservation of fruits and vegetables were also obtained. Farm home production of many fruits and vegetables was adequate, but the production and preservation of tomatoes and greens should be greatly increased.

Wilma D. Brewer, Alice M. King

MISCELLANEOUS

The Effect of Temperature, Soil Reaction, and Soil Nutrients on the Growth of Gerbera in the Greenhouse

The group of seedling plants grown in sand culture during the previous year were transferred to soil in galvanized pails, one plant per pail. These were divided into three lots of seven each. One lot was left untreated as a control. The second lot was given 18 grams of complete 8-16-16 fertilizer for each plant in a layer two inches from the bottom of the pail. The third was treated with 21 grams of ammoniated superphosphate per plant and placed in the same manner. Five grams of each kind of fertilizer were added to the top soil of each of the respective treated pails at about monthly intervals, and records were kept of salable blooms.

The number of blooms in the control pots actually outnumbered those which were treated. During the later months the fertilized plants caught up with the controls and out-produced them.

Eight plots of 30 plants each were given the following treatment: 4 plots were located in each of two greenhouses in similar positions with regard to light. One group was held at 50° night temperature and the other at 60°. Alternate plots in each group were limed until the soil reaction tested approximately pH 7. The pH of the control plots ranged from 5.48 to 5.95. Records were kept of salable blooms per month. Those held at 50° produced more blooms than those held at 60°. This difference may or may not be significant. The smaller production at 60° is due at least in part to an increase in the insect pests of the gerbera. Pill bugs, red spider mite, and thrip are much more troublesome and difficult to control at 60°.

The total blooms resulting from the soil reaction treatments show no significant difference in production between pH 6 and pH 7.

STUART DUNN, W. D. HOLLEY

Nut Improvement

A variety of hazel, the Winkler, has made a good record as a nut producer. The nuts are very much larger than ordinary hazel. Three-year-old bushes produced two-thirds of a quart of hulled nuts per plant. Butternut seedlings secured from seed planted in 1941 have now reached a height of six feet in many cases. These are the progeny of the best native trees. Attempts to propagate butternuts by grafting have thus far proved futile.

L. P. LATIMER, A. F. YEAGER

A Study of the Performance During Wear of Women's and Children's Silk, Rayon and Cotton Wearing Apparel Fabrics

The Northeastern regional station in a co-operative textile project was organized in 1935. Since that time the textile laboratories of the Pennsylvania station have conducted various tests to determine the colorfastness and durability of samples of fabric submitted by consumers from yard goods used for making women's or children's wearing apparel. A

wearing record of the garment was kept and the garment submitted for testing after it was well worn. From New Hampshire, 98 samples of fabric have been sent to the Pennsylvania station since the beginning of the project.

The problem is of importance during war time since the durability and colorfastness of textile fabrics are significant features necessary to the long wearing of garments.

Hazel M. Hill (resigned), Daisy D. Williamson (deceased)

STATION SERVICE

The work of the Agricultural Experiment Station is not limited to active research projects. The staff members are constantly serving the public as a part of their regular duties as specialists in their respective fields. The major aspects of these contributions are explained below. However, these do not include the routine work of departmental administration and the time consumed in answering the numerous inquiries in the fields of animal and plant production, particularly during the summer months. The identification of plants, of diseases and insects, and advice on the control of weeds, use of hormones, etc., are all a part of these public services. Some types of inquiries have been noticeably numerous during the current season of Victory gardens—numerous letters to gardeners and farmers in response to inquiries on vegetables, small fruits, tree fruits, and ornamentals. In a few instances the station personnel has collaborated in writing extension bulletins of current interest and as a matter of contributing to the war effort.

Inspection of Fertilizers and Feeding Stuffs and Soil Testing

In accordance with the public statutes regulating the sale of commercial fertilizers and of concentrated commercial feeding stuffs, 84 brands of fertilizers and 461 brands of feeding stuffs were analyzed by staff members of the department of Agricultural and Biological Chemistry during the year 1942-43. These analyses involved individual determinations totaling 540 and 3530 respectively. In addition, 46 samples of feeding stuffs, fertilizers and other materials have been analyzed for state residents, involving 170 determinations.

T. O. Smith, H. A. Davis

The staff members of this department also have made a chemical analysis of 1050 samples of soil taken from the fields, gardens, lawns, and pastures throughout the state.

G. P. Percival

Seed Inspection

The regular seed inspection work for the State Department of Agriculture was conducted as usual. During the year 360 samples of seed were handled in the laboratory. Of this number 218 were collected by

state inspectors and will be reported in Bulletin 349; the remaining 142 samples were sent in by private individuals. Furthermore, the usual referee work was continued.

Competent staff members have succeeded in getting the last session of the legislature to pass a new seed law. The following three new features are included in this law: all vegetables and agricultural seed are now required to be tested within nine months of being offered for sale; a noxious weed law is included forbidding certain weed seeds from being shipped into the state; and a vegetable seed law is included.

Bessie G. Sanborn

Potato Seed Certification

This service to the potato seed growers of the state was established and carried on for many years by Dr. O. R. Butler, botanist of the Experiment Station. After his death, in 1940, the work was done cooperatively with the State Department of Agriculture. Most of the field inspection work was gradually shifted until the season of 1942 when it was entirely absorbed by the state department.

In 1943 the Experiment Station was again asked to help out in the emergency, and Stuart Dunn, the station plant physiologist, was assigned to take charge in June, 1943. He had previous experience in the work under Dr. Butler and had charge of it during the latter's last illness. The total acreage during the current season is 147.12, all in the Colebrook area in the northern part of the state.

Beginning in 1941 a greenhouse test was required of all potato seed submitted for certification. This is carried out with the aid of the station pathologist, M. C. Richards. Each grower is required to submit to the station at Durham a sample of tubers from each field to be certified. Plants are grown from these in the greenhouse, during late winter, and the disease readings are used to supplement the field inspection reports. This is in lieu of a Florida test required by certifying agencies in some other states.

Stuart Dunn

Dairy Bacteriology Testing

For the year ending June 30, 1943, 1698 samples of milk have been tested for bacteria. The individual farmer samples were first pasteurized and then the standard plant count was made on the pasteurized samples. Of the total samples tested, 1066, or 62.8 per cent, had a count below 10,000, and only 95, or 5.6 per cent, had a count of 100,000 or more.

Other services conveyed under dairy bacteriology testing include the Babcock testing of milk samples, the calibration of Babcock glassware, and the supplying of the Babcock glassware to the D. H. I. A. testers. Nearly 100 samples of milk were tested for fat for people who brought, or sent, their samples to the station at Durham. During the year 908 milk test bottles and 84 pipettes were calibrated.

H. C. Moore

Mastitis Diagnosis

To enable veterinarians and dairymen to obtain an accurate diagnosis of bovine mastitis for the control and treatment of this disease, facilities have been provided for a laboratory test by the Experiment Station. This service is available to all New Hampshire dairymen and veterinarians at a charge of $.25 per sample.

One composite sample from each cow is sufficient for the test. If treatment is to be administered, then it is advisable to test individual quarter samples from a cow to determine which quarters are infected and therefore require treatment. Sample bottles can be obtained by writing to the Bacteriology department. Directions for taking the samples are submitted with the bottles.

During the fiscal year 1942-43, a total of 325 samples was tested for New Hampshire dairymen.

L. W. Slanetz

National Poultry Improvement Plan

Record of Performance: During this past year there were 12 farms or 15 flocks of chickens under the national plan and one flock of turkeys under state supervision. These 15 flocks had a total farm population of 54,893 birds, including 6,054 under supervision of the state inspector.

Certified: Eight flocks, involving 20,570 birds, were certified during the year.

Approval: The U. S. Approval Stage of the plan had a decided increased participation this year. There were 263 flocks that were handled by qualified flock selecting agents and their work was checked by the official state inspector. This was an increase of 94 flocks over the year 1941-42. The total number of birds under this stage of the plan was 518,922 compared with 302,613 in 1941-42.

H. E. Parker

Pullorum Testing

Over the last fiscal year, 1942-43 more hens and related fowl were tested for pullorum disease than in any previous year since the program was inaugurated in 1918-19, when 4,000 birds were tested. In 1920-21, 11,400 birds were tested. At that time 60 per cent of the flocks tested and 7.66 per cent of the birds in these flocks were found to be infected with pullorum disease.

In contrast to the above figures the staff tested 1,056,191 birds during the year, and re-tested 58,908 birds, making a total number of 1,115,099 samples analyzed. These birds were from 599 flocks of which 20 flocks were found to be infected. The infected flocks had a total of 1,317 infected birds. Thus 3.33 per cent of the 599 flocks were infected and .124 per cent of the total number of birds tested were found to be infected.

Although the amount of infection in both flocks and birds had increased over the previous year, the picture is very satisfactory. The reason is that the poultry population has greatly increased, and many new

persons have entered the poultry field, thus increasing the hazards because of the introduction of stock from states with a pullorum status not nearly as good as that of our state.

FRED E. ALLEN

Blue Comb

In September 1941, we were able to isolate a filterable virus from birds affected with the acute form of "Blue Comb" disease. This has been grown on chick embryos and a vaccine prepared from the membranes of the infected embryo. This year we have used this experimental vaccine in five flocks on previously infected farms. Approximately 17,000 birds are under observation.

E. F. WALLER

Infectious Bronchitis Work

In May 1943, we started to use egg-propagated infectious bronchitis virus to immunize chicks against this disease. Up to June 30, 1943 we had used this virus on 19 flocks containing 36,000 birds. The office of the state veterinarian has limited the use of this virus to infected farms and has specified that it be administered by one of the veterinarians from the poultry laboratory.

E. F. WALLER

Manufacture of Fowl Laryngotracheitis Vaccine

During the year 1942-43, 50,250 doses of laryngotracheitis vaccine were distributed to flock owners in the state. This quantity was used on nine farms in four counties. The vaccine is used only on infected farms and usually not until the disease makes its appearance in the flock.

Disease-free, broiler-age birds are used to produce this vaccine. It is made and sold under federal license and must meet the rigid purity and potency tests of the U. S. Department of Agriculture, Bureau of Animal Industry.

E. F. WALLER

Manufacture of Fowl Pox Vaccine

During the year 1942-43, 352,500 doses of fowl pox vaccine were distributed to 204 poultry flock owners in the state. This was a decrease of about 100,000 doses under that sold for the previous year.

The vaccine is manufactured and sold under federal license, number 194, and sales have been limited to poultrymen of the state. All birds used in the manufacture of the vaccine are procured from the university poultry farm. They must be in perfect health, such being assured by appropriate blood and laboratory tests. After the vaccine is produced, it must meet the rigid federal requirements as to purity and potency before it can be released to the poultrymen. These tests are the poultryman's insurance against introducing organisms of other diseases when vaccinating his stock for fowl pox.